ESD-TDR-63-603

BIBLIOGRAPHY OF HUMAN FACTORS RESEARCH

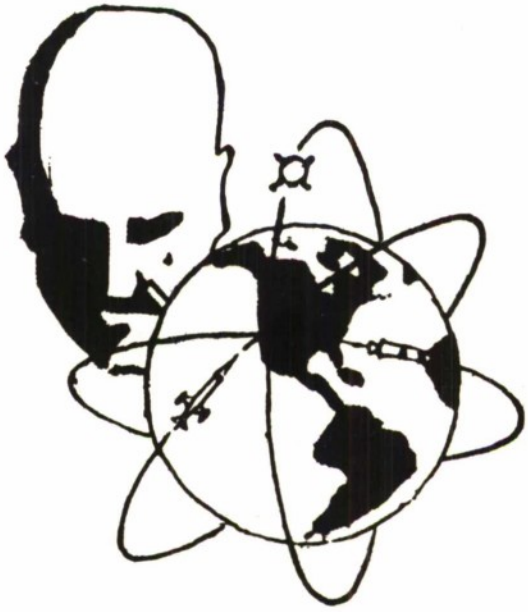
WITH ABSTRACTS, 1954 THROUGH 1962

AUGUST 1963

TECHNICAL DOCUMENTARY REPORT ESD-TDR-63-603

J. P. Gonon, Capt, USAF (Res)

DECISION SCIENCES LABORATORY
DEPUTY FOR ENGINEERING AND TECHNOLOGY
ELECTRONIC SYSTEMS DIVISION
AIR FORCE SYSTEMS COMMAND
L. G. HANSCOM FIELD, BEDFORD, MASS.



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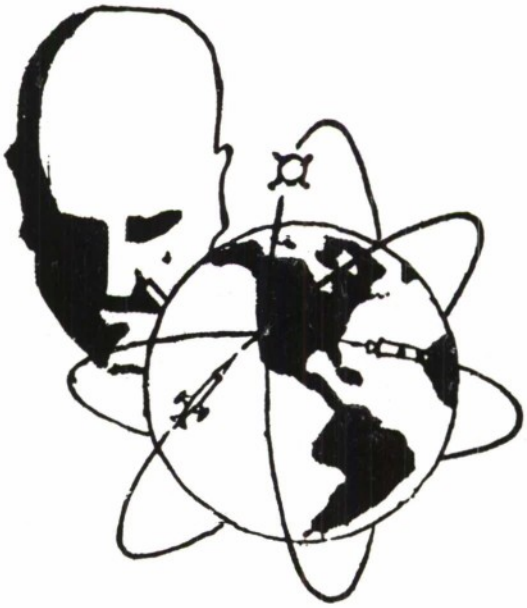

ACKNOWLEDGMENT

The editor wishes to express his appreciation to Miss C. Dolores Celi for her meticulous attention to detail and for her patient, good humoured, and sustained assistance in the preparation of this bibliography.

ESD-TDR-63-603

BIBLIOGRAPHY OF HUMAN FACTORS RESEARCH WITH ABSTRACTS,

1954 THROUGH 1962

ABSTRACT

This bibliography contains unclassified abstracts of selected Technical Documentary Reports issued by the Decision Sciences Laboratory, Electronics System Division, Air Force Systems Command, during 1954 through 1962. The major areas comprising the Laboratory's mission are the performance of behavioral science research, development, and testing to advance command and control system technology, and the implementation of research findings to impr.ve the design and performance of Command and Control Systems. The bibliography contains three indices, cross-referencing the reports by author, by organization, and by specialized categories: (1) Statistics, Measurements and Methods, (2) Psychophysical Research (Audition and Vision), (3) Perception and Cognition, (4) Learning and Training, (5) Group Processes, (6) Psycholinguistics, (7) Systems Research (Design and Analysis, Human Engineering, Personnel, Test and Evaluation, Training), (8) Bibliographies, Handbooks, and Indexes, and (9) Equipment.

This Technical Documentary Report has been reviewed and is approved.

FOR THE COMMANDER:

ANTHONY DEBONS
Colonel USAF
Director, Decision Sciences Laboratory
Deputy for Engineering and Technology

J. P. Gonon, Capt USAF (Res)
Decision Sciences Laboratory
Deputy for Engineering and Technology

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TECHNICAL NOTES

(1)
AFCRC-TN-54-50 February 1954

Pollack, Irwin; Pickett, J. M.; Sumby, William H. (Operational Applications Laboratory)

ON THE IDENTIFICATION OF SPEAKERS BY VOICE (J. Acoust. Soc. Am., Vol. 26, No. 3, 403-406, May 1954

The effect of several factors upon voice identification was examined. These factors were: the size of the class of possible voices, the duration of the speech signal, the frequency range of the speech signal, voicing vs nonvoicing speech characteristics, and the simultaneous presentation of several voices. One of the most effective factors for speaker identification was the duration of the speech signal. Duration, as such, appears to be important, however, only insofar as it admits a smaller or larger statistical sampling of the speaker's speech repertoire.
Project 7682
ASTIA No. AD95905

(2)
AFCRC-TN-54-51 August 1954

Pollack, Irwin (Operational Applications Laboratory)

METHOD OF REPRODUCTION AND THE IDENTIFICATION OF ELEMENTARY AUDITORY DISPLAYS (J. Acoust. Soc. Am., Vol. 26, No. 6, 1060-1063, Nov 1954)

A psychophysical procedure which combines the salient features of the classical discrimination and identification experiments is described. Improvement in the identification of aspects of elementary auditory displays is associated with the procedure. However, the improvement is only a fraction of that reasonably expected on the basis of a classical differential threshold analysis.
Project: 7682
ASTIA No. AD75245

(3)
AFCRC-TN-54-52 August 1954

Pollack, Irwin (Operational Applications Laboratory)

INTENSITY DISCRIMINATION THRESHOLDS UNDER SEVERAL PSYCHOPHYSICAL PROCEDURES (J. Acoust. Soc. Am., Vol. 26, No. 6, 1056-1059, Nov 1954)

Discrimination thresholds for the detection of a change in the sound level of a tone were obtained under five experimental procedures. These procedures differed primarily in terms of the presence or absence of an objective comparison signal and in terms of the stability of the test conditions under examination. Under comparable conditions, discrimination in the absence of an objective comparison signal is only slightly less acute than in the presence of such a signal. On the other hand, relatively large increments in the detection thresholds are associated with increases in the instability of the testing conditions, especially over long discrimination intervals. The results are examined in terms of molar concepts more pertinent to the listener than to the ear.

Project: 7682
ASTIA No. AD75246

(4)
AFCRC-TN-54-53 November 1954

Pollack, Irwin (Operational Applications Laboratory)

SOUND LEVEL DISCRIMINATION AND VARIATION OF REFERENCE TESTING CONDITIONS (J. Acoust. Soc. Am., Vol. 27, No. 3, 474-480, May 1955)

The accuracy of discrimination of small changes in sound level was examined as a function of the magnitude, temporal, and dimensional aspects of the variation between two reference testing conditions. Precision of sound level discrimination declined as: the magnitude of the sound level difference between the two reference conditions increased and as the frequency of occurrence of shifting between the two reference conditions increased. Of lesser importance was the temporal interval between successive discriminations, variation in the audio-frequency of the reference signals, and the predictability of the to-be-presented testing conditions. The results are considered in terms of a preliminary analysis of psychological dimensions in auditory discrimination.

Project: 7682
ASTIA No. AD75247

(5)
AFCRC-TN-54-54 November 1954

Pollack, Irwin (Operational Applications Laboratory)

MASKING BY A PERIODICALLY INTERRUPTED NOISE (J. Acoust. Soc. Am., Vol. 27, No. 2, 353-355, Mar 1955)

A scale of noise intermittancy may be represented at one extreme by a continuous noninterrupted noise and, on the other extreme, by an interrupted noise with silent intervals between successive noise bursts. The differential characteristic for various conditions along this scale is the noise level in the interval between successive noise bursts (the inter-burst level). The effects of a wide range of periodically intermittant noise conditions upon the masked threshold of a tone and the intelligibility of speech were examined. The principal result of these tests is that the masked threshold associated with an intermittant noise can be closely described by two functions: (1) the masking produced by an interrupted noise with silent intervals between successive noise bursts, and, (2) the masking produced by a continuous uninterrupted noise at the inter-burst level.
Project: 7682
ASTIA No. AD75248

(6)
AFCRC-TN-54-75 August 1953

Neisser, Ulric (Massachusetts Institute of Technology)

AN EXPERIMENTAL DISTINCTION BETWEEN PERCEPTUAL PROCESS AND VERBAL RESPONSE (J. Exp. Psychol., Vol. 47, No. 6, 399-402, Jun 1954)

Twelve Ss were given a list of ten words to study for 1 min. Tachistoscopic duration thresholds were secured on five words from this list, five words which were homonyms of items on the list, and five control words. A balanced design was used. The results indicate that the preliminary presentation facilitated the recognition of specific items on the list, but in no way facilitated the recognition of their homonyms. Since the same verbal response is employed in reporting a homonym as in reporting the word itself, it appears that the effect of a set of this type is to facilitate recognition processes without generally facilitating the corresponding verbal responses. This conclusion may be related to certain recurrent problems in the interpretation of perceptual data.

Project: 7682 Contract No. AF18(600)-322
ASTIA No. AD94118

(7)
AFCRC-TN-55-1 June 1956

Kryter, Karl D. (Operational Applications Laboratory)

ON PREDICTING THE INTELLIGIBILITY OF SPEECH FROM ACOUSTICAL MEASURES (J. Speech and Hearing Disorders, Vol. 21, No. 2, 208-217, Jun 1956)

It is the purpose of this paper to review briefly some of the methods used for predicting speech intelligibility test scores from acoustical measures. The Bell Telephone Laboratories' twenty band method of measuring speech communication, the octave-band procedures of measuring speech communication, frequency distortion, masking by noise, and difficulties in predicting person-to-person speech communications with present acoustical measures are discussed.

Project & Task: 7682-76821
ASTIA No. AD129689

(8)
AFCRC-TN-55-2 1956

Klemmer, Edmund T. (Operational Applications Laboratory)

TIME UNCERTAINTY IN SIMPLE REACTION TIME

This report describes a simple reaction-time (RT) experiment with careful control of foreperiod length and variability and control of stimulus repetition rate. Six Ss were given two series of simple reaction time tests. In the first series the effect of changes in mean foreperiod and foreperiod variability were systemmatically investigated. In the second series the effect of spacing between stimuli was studied with no warning signal. These tests were designed to determine the relation between RT and S's uncertainty about time of stimulus presentation. The results show that RT increases with foreperiod variability and with mean foreperiod above some small optimum value less than 1 sec. In a sequence of trials, the immediate foreperiod influences RT only if the previous foreperiod is different from it, and then only slightly. The striking finding on all tests with variable foreperiod is that the important determiner of RT is not the immediate foreperiod but rather the distribution of foreperiod within which it is embedded.

Project & Task: 7682-76821

(9)
AFCRC-TN-55-3 January 1956

Klemmer, Edmund T. (Operational Applications Laboratory)

RHYTHMIC DISTURBANCES IN A SIMPLE VISUAL-MOTOR TASK (Am. J. Psychol., Vol. 70, No. 1, 56-63, Mar 1957)

A series of tests was designed to investigate rhythmic difficulty in key-pressing to flashing lights. All tests were made with a stimulus-repetition rate of 2 per-sec. The stimulus was a single lighted lamp mounted alone, or, in other tests, in a bank of five placed in front of five keys. When five lamps were used, the position of the lighted one changed either randomly or regularly. S was instructed to hit one key after each light. In some tests he pressed one out of five keys, in other tests he pressed the same key each time regardless of light position. In only one of the six tests so formed was a discriminative response required, that is, in only one test was S required to transmit information about light-position. In all other tests S knew in advance what each stimulus and response would be. The results for five Ss on the six tests showed that: (1) Only when there was uncertainty both about the position of the next light and the response to it were all Ss able to maintain a consistent phase-relation between stimulus and response. (2) The lack of discriminative response led either to an irregular distribution of responses over the entire inter-stimulus interval or to a piling up of responses close to the stimulus. (3) Instructions to respond simultaneously with the stimulus produced distributions very similar to those for instructions to respond after each stimulus.

Project & Task: 7682-76821
ASTIA No. AD110074

(10)
AFCRC-TN-55-4 November 1955

Klemmer, Edmund T. (Operational Applications Laboratory)

TIME SHARING BETWEEN AUDITORY AND VISUAL CHANNELS

Three Ss were given tests in which they attempted to follow flashing lights and brief tones by pressing appropriate keys. Only one channel was activated at a time and the rate of alternation between channels was varied systematically between tests. The rate of stimulus presentation in the active channel was 2 per sec. and 3 per sec. in separate tests. The results indicated that forcing S to alternate regularly between tasks more rapidly than once every 2 sec. lowers his over-all performance sharply. It also appeared that forced time sharing between tasks of different difficulties leads to a greater decrement in performance on the easier task. The average reaction time during alternation was close to that for the more difficult channel alone.

Project & Task: 7682-76814

(11)
AFCRC-TN-55-5 November 1955

Pollack, Irwin (Operational Applications Laboratory)

IDENTIFICATION AND DISCRIMINATION OF COMPONENTS OF ELEMENTARY AUDITORY DISPLAYS (J. Acoust. Soc. Am., Vol. 28, No. 5, 906-909, Sep 1956)

The absolute identification and differential discrimination of the sound level of tones were studied over a wide range of sound levels under comparable experimental conditions, and the results of the two experiments were compared in comparable units. Absolute identification improves and differential discrimination deteriorates as the range of sound levels examined increases. The net effect of these complementary changes is that the information associated with differential discrimination is roughly of the same magnitude as that associated with absolute identification.

Project & Task: 7682-76821
ASTIA No. AD128806

(12)
AFCRC-TN-55-6 November 1955

Spieth, Walter (Operational Applications Laboratory)

ANNOYANCE THRESHOLD JUDGMENTS OF BANDS OF NOISE (J. Acoust. Soc. Am., Vol. 28, 872-877, Sep 1956)

Annoyance threshold judgments were obtained by exposing an individual to noise for three minutes and asking him to adjust the intensity to the level which, if any louder, would annoy him if it were present most of the time where he was working. In one experiment, 21 people made judgments about 13 bands of noise which covered the frequency range of 50 to 13000 cps, and subsequently made sets of equal loudness matches. No differences were found between annoyance threshold curves and equal loudness curves. In a second experiment, each of 162 people made one annoyance judgment. When these annoyance thresholds were transformed into equivalent loudness terms, the resultant annoyance threshold curve varied reliably with frequency only in that the threshold on the highest band (6600-9000 cps) was reliably lower than those on lower frequency bands. Office workers who had once worked in noisy situations as well as those working in noisy situations at the time of the experiment gave thresholds about 15 db higher than did people who had only worked in office-type situations. Within a group who had worked only in quiet situations, those who tried to imagine themselves in an actual working situation gave thresholds that averaged about 15 db bigher than the thresholds of workers who did not.

Project & Task: 7682-76821

(13)
AFCRC-TN-55-50 July 1955

Oyer, Herbert J. (Ohio State University)

RELATIVE INTELLIGIBILITY OF SPEECH RECORDED SIMULTANEOUSLY AT THE EAR AND MOUTH (J. Acoust. Soc. Am., Vol. 27, No. 6, 1207-1212, Nov 1955)

Monosyllabic words recorded at the lips and left ears of six speakers were fed to the headsets of 24 trained listeners at -12, -15, and -18 S/N ratios. Although the trend for intelligibility scores throughout the test is in the same direction for signals of both origins, decreasing S/N ratio is more destructive to the speech picked up at the lips.

Project & Task: 7681-76813 Contract No. AF18(600)-316
ASTIA No. AD59343

(14)
AFCRC-TN-55-52 February 1955

Moser, Henry M.; Dreher, John J. (Ohio State University)

PRELIMINARY MAYDAY-SOS COMPARISON

MAYDAY gives listening scores superior to SOS when tested with foreign speakers in heavy noise.

Project & Task: 7681-76813 Contract No. AF18(600)-316
ASTIA No. AD57642

(15)
AFCRC-TN-55-53 March 1955

Moser, Henry M.; Dreher, John J.; Oyer, Herbert J. (Ohio State University)

THE RELATIVE INTELLIGIBILITY OF SPEECH RECORDED SIMULTANEOUSLY AT EAR AND MOUTH (Supplementary Report No. 1)

Indications from the preliminary phase of investigation are followed up herein. Speech signals were recorded simultaneously at the left ears and lips of six adult male speakers. Test materials consisted of 50 monosyllabic words of high frequency in air operations, selected from a sampling of 120 CAA control towers. These words were balanced to approximate closely the vowel and diphthong occurrence in English monosyllables. Each speaker recorded six randomized lists. These lists were presented randomly with respect to origin to a panel of 24 trained listeners in quiet and at five S/N ratios. The criterion measure employed was the total number of correct responses to six speakers for each listener at each S/N ratio considered. Origin of speech signal, S/N ratio, and listener constituted the three factors in the design. Analysis of results obtained from this investigation indicate the following conclusions: (1) When heard in quiet, speech picked up by a transducer coupled to a fitted ear mold (in the ear of the speaker) is as intelligible as speech recorded simultaneously at the lips of the speaker by a second transducer (same model). (2) Decreasing S/N ratio is significantly destructive to the intelligibility of speech signals picked up from the ear or mouth speakers and more destructive to those from the latter source. (3) The ear signal is superior to the mouth signal at the 6 percent level of confidence when both are heard at -12 db S/N ratio. (4) Ear signals become relatively more intelligible than mouth signals as the S/N ratio decreases. (5) Inasmuch as a usable signal of good quality can be picked up from the ear with existing equipment, further work on engineering a microphone for the specific nature of the ear signal would be warranted.

Project & Task: 7681-76813 Contract No. AF18(600)-316
ASTIA No. AD59342

(16)
AFCRC-TN-55-54 March 1955

Moser, Henry M.; Dreher, John J.; Adler, Sol (Ohio State University)

EFFECT OF VOCAL INFLECTION ON THE INTELLIGIBILITY OF TWO-UNIT SIGNALS

Native American listeners recognize three gross inflection patterns in speaking: rising, level, and falling. These three patterns, combine to make nine paired sequences, were applied to four types of two-unit signal: (1) Intoned vowel pairs, (2) Two-digit numbers, (3) ICAO alphabet word pairs, (4) Digit-word pairs. Responses of trained subjects at -9, -12, and -15 db S/N ratios indicate that: (1) The rank order effectiveness of the nine contour sequences differ somewhat with the type of signal transmitted. (2) Generally speaking, flat-flat(--) and rising-rising (//) inflections are best with all types of two-unit signal. (3) With all signals there is noted a "mirror image" effect, in which a time-order reversal of contour is consistently damaging to the message (e.g. if rising-rising was good then falling-falling was significantly worse, and so on with the rest of the sequences). (4) Intensity of a contour is unaffected by its tonal environment.

Project & Task: 7681-76813 Contract No. AF18(600)-316
ASTIA No. AD62202

(17)
AFCRC-TN-55-56 June 1957

Moser, Henry M.; Dreher, John J.; Oyer, Herbert J. (Ohio State University)

ONE-SYLLABLE WORDS

This report presents a systematic listing of the monosyllabic words in American English. There have been requests from the military services for additional single—syllable words to supplement those already used in radiotelephone communication. This list can also be utilized in language studies, such as the frequency of occurrence of sounds alone, and in combination with other sounds. Arrangement of the words in the list is according to sound.

Project & Task: 7681-76814 Contract No. AF19(604)-1577
ASTIA No. AD110093

(18)
AFCRC-TN-55-57 August 1955

Carterette, Edward C. (Indiana University)

LOUDNESS ADAPTATION FOR BANDS OF NOISE (J. Acoust. Soc. Am., Vol. 28, No. 5, 865-871, Sep 1956)

Loudness adaptation may be measured by a simultaneous loudness balance, or as in the two experiments described in this report, by a median plane localization of a dichotically presented acoustic stimulus. The loudness of a steady auditory stimulus generally decreases with time. That is, the intensity of a comparison stimulus in the rested ear is ordinarily set below the intensity in the stimulated ear. Two experiments were done on loudness adaptation for bands of noise. In Experiment 1, using 36 subjects, loudness adaptation for a wide-band thermal noise of 100-5000 cps was studied as a function of five SPL's: 40, 70, 90, 100, and 105 db over all. The mean maximum loudness adaptation obtained was 2.3, 9.9, 11.4, 14.4, and 16.3 db respectively. The mean standard deviation for all measures was 6.1 db, and the distributions of the sets of measures tended to be skewed toward greater adaptation. In Experiment 2 (12 subjects), the loudness adaptation for a 1500-cps tone was compared with that for bands of noise whose centers (mel scale) were at 1500 cps, and whose over-all SPL's were equal to the SPL of the pure tone. The band limits in cycles per second were 1280-1720, 1075-1950, 720-2600, and 100-4900. For each band, adaptation was measured for 50, 70, and 90 db SPL over all. The essential results are: (1) Loudness adaptation for 1500 cps is about 8.5 db greater than the maximum adaptation for any noise band at any SPL; (2) Adaptation is small (4.5 db) at 50 db for all bands of noise; it is complete within one minute and is about equal for all band widths; (3) at 70 and 90 db, time taken for complete adaptation increases and the two widest bands give greater adaptation than the two narrowest bands. At 90 db a trend becomes clear: the wider the band, the greater the degree of adaptation and the longer the time required for maximum adaptation to be attained.

Project & Task: 7681-76814 Contract No. AF18(600)-571
ASTIA No. 117720

(19)
AFCRC-TN-55-58 June 1955

Egan, James P.; Thwing, Edward J. (Indiana University)

FURTHER STUDIES ON PERSTIMULATORY FATIGUE (J. Acoust. Soc. Am., Vol. 27, No. 6, 1225-1226, Nov 1955)

Perstimulatory fatigue, or auditory adaptation, was measured by various procedures which were designed to determine (1) the effects of brief re-stimulation of the adapted ear, and (2) the role of sound localization.

Project & Task: 7681-76814 Contract AF18(600)-571
ASTIA No. 84767

(20)
AFCRC-TN-55-59 June 1955

Moser, Henry M.; Dreher, John J.; Adler, Sol (Ohio State University)

THE EFFECTS OF CONTROLLED AFFECTIVE TONE ON INTELLIGIBILITY

Four professional actors recorded a random selection of two-digit numbers conveying four different types of controlled emotion: anger, fear, sadness and unemotionality. Articulation scores obtained for each of the emotions indicated the following: (1) The overlay of controlled emotion added nothing to intelligibility and (2) The speaker scores were, in general, highly modal, allowing for the conclusion that trained stage people give a uniform portrayal of the various emotions.

Project & Task: 7681-76813 Contract AF18(600)-316
ASTIA No. AD76380

(21)
AFCRC-TN-55-60 July 1955

Moser, Henry M.; Dreher, John J.; Adler, Sol (Ohio State University)

A COMPARISON OF HYPONASALITY, HYPERNASALITY, AND NORMAL VOICE QUALITY ON THE INTELLIGIBILITY OF TWO-DIGIT NUMBERS

Six Eastern and general American speakers, using hyponasal, hypernasal and normal voice qualities recorded random lists of two-digit numbers for presentation in noise to 11 trained listeners, all of whom had 32 hours practice in listening and testing in noise. Results indicate that, while voice qualities acted in a relatively similar manner at both signal-to-noise ratios tested, hypernasality was destructive to intelligibility under both conditions, hypernasality was destructive at the milder noise level, and normal delivery was best throughout.

Project & Task: 7681-76813 Contract AF18(600)-316
ASTIA No. AD76381

(22).
AFCRC-TN-55-61 June 1955

Moser, Henry M.; Dreher, John J.; Adler, Sol (Ohio State University)

THE EFFECTS OF CONTROLLED BOUNCE BLOCK AND PROLONGED BLOCK ON THE INTELLIGIBILITY OF OPERATIONAL WORDS

The purpose of this study was to compare the efficiency of normal bounce block and prolonged block methods of voice transmission for phonetically balanced (PB) words of high frequency in air operations. It was concluded that the bounce block materially aids transmission of the PB monosyllables under unfavorable reception conditions. Under the same conditions the prolonged block method was inferior to both other types of delivery.

Project & Task: 7681-76813 Contract AF18(600)-316
ASTIA No. AD76382

(23)
AFCRC-TN-55-62 July 1955

Moser, Henry M.; Dreher, John J.; Adler, Sol (Ohio State University)

POSITION AND WEATHER TELLING METHODS

Three methods of position and weather telling were tried. These were: (1) Tag-word method (Separation by tag-word and minimum pause); (2) Plain telling (Separation by distinct pauses); and (3) Fast telling (Separation by minimum pauses). Two aspects of speed were varied in the telling styles: words per min (rate of speaking) and time of message (rate of telling). For accuracy, in telling digit encoded weather messages, the plain telling style with definite pauses between message elements was most effective. It would seem that if a weather and position form is adopted for general military use, the optimum spacing of message elements is the indicated direction for future study. In the light of experimental results the use of tag-words would not be recommended. A further conclusion would be that some practice in a very fast rate is desirable even if that rate may not be authorized officially since in the event of use of prohibitively fast telling a greater amount of the message is salvaged by listeners who had previously approached this condition in transcribing information.

Project & Task: 7681-76813 Contract AF18(600)-316
ASTIA No. AD 76383

(24)
AFCRC-TN-55-63 September 1955

Licklider, J. C. R. (Massachusetts Institute of Technology)

AUDITORY FREQUENCY ANALYSIS (Information Theory, Third London Symposium, Sep 1955)

The purpose of this paper is to re-examine the theory of how frequency analysis in hearing is made, looking briefly both at theories and at facts, and to describe the results of observations made in order to check conflicting reports or to provide a basis for choosing among conflicting formulations. The outcome of the paper is a "triplex" theory of pitch perception. It outlines a mechanism that accounts for the three ways in which acoustic stimulation can give rise to subjective pitch and, at the same time, brings into mutual relation a number of facts from other parts of auditory experience.

Project & Task: 7681-76817 Contract No. AF18(600)-1219
ASTIA No. AD 117901

(25)
AFCRC-TN-55-64 May 1956

Moser, Henry M.; Dreher, John J.; Oyer, Herbert J. (Ohio State University)

THE RELATIVE INTELLIGIBILITY OF SPEECH RECORDED SIMULTANEOUSLY AT EAR AND MOUTH (Supplementary Report No. 2)

In the present study the lip microphone used was the noise cancelling M33/AIC. The simultaneous recording of test words was done in a high ambient field. The purpose of the experiment was to compare the effectiveness of the noise cancelling microphone with that of the ear-insert microphone (Dyna-Lab D-69 Magnetic Insert Transducer) when the latter has been afforded some degree of noise shielding. Results indicate that the ear-insert microphone is superior to the noise-cancelling microphone under controlled noise conditions.

Project & Task: 7681-76814 Contract No. AF19(604)-1577
ASTIA No. AD100736

(26)
AFCRC-TN-55-65 August 1955

Thwing, Edward J. (Indiana University)

EFFECT OF REPETITION ON ARTICULATION SCORES FOR PB WORDS (J. Acoust. Soc. Am., Vol. 28, No. 2, 302-303, Mar 1956)

Naive listeners were administered PB word articulation tests under four conditions of successive repetition and three conditions of signal-to-noise ratio. At all three signal-to-noise ratios, successive repetition of test words yields slightly higher articulation scores. The major portion of improvement in scores occurs with the second presentation; third and fourth presentations have negligible effect.

Project & Task: 7681-76814 Contract AF18(600)-571

(27)
AFCRC-TN-55-66 August 1955

Moser, Henry M. (Ohio State University); Bell, G. E. (Ministry of Transport and Civil Aviation, London, England)

JOINT US-UK REPORT SUMMARY STATEMENT ON NUGGET-NOVEMBER TESTS

Listener tests of NOVEMBER and NUGGET are described for possible future use in the International Civil Aviation Organization (ICAO) alphabet. It is recommended that NECTAR be replaced with NOVEMBER.

Project & Task: 7681-76813 Contract No. AF19(604)-1577
ASTIA No. AD101513

(28)
AFCRC-TN-55-67 October 1955

Egan, James P.; Clarke, Frank R.; Carterette, Edward C. (Indiana University)

ON A THEORY OF THE TRANSMISSION AND CONFIRMATION OF MESSAGES IN NOISE

In a series of experimental studies, the severe restrictions imposed upon the communication process by an articulation test were slightly relaxed by increasing the number of events in the communication sequence. This report presents some of the theoretical considerations which have grown out of this research. A communication event refers to the transmission of a message from a talker (the source) to a listener (the receiver) followed by the return of a message (correct or incorrect) from the receiver to the source for confirmation. Although both source and receiver serve successively as talker and listener, the relation between them is asymmetric. Since the source already knows the original message, he must accept or reject the message sent back to him according to some criterion level. Various types of communication events arise depending upon (1) whether or not the receiver correctly hears the message, and (2) whether or not the source confirms the message sent back to him by the receiver. The various probabilities associated with these types of communication events are defined. The behavior of the source is of particular interest, and the relations between the two conditional probabilities associated with a correct and with an incorrect confirmation are discussed in some detail. If the same message is sent over and over until the source confirms it, a sequence of communication events is generated. A simple mathematical model is presented that accurately describes this process. The following important theorem is established for a wide class of relations between the conditional probability of a correct confirmation and the conditional probability of an incorrect confirmation. If each message in a set of N messages is sent over and over until all messages are confirmed, then the total number of incorrect confirmations will be larger under a relaxed criterion than under a more stringent one. This statement is true even though the total number of communication events is smaller under the relaxed than under the strict criterion.

Project & Task: 7681-76814 Contract No. AF18(600)-571
ASTIA No. AD78577

(29)
AFCRC-TN-55-68 May 1956

Moser, Henry M.; Dreher, John J.; Adler, Sol (Ohio State University)

EFFECT OF RATE AND PHRASING ON INTELLIGIBILITY OF AIR MESSAGES

On the basis of overall scores covering the six message types in this experiment, no statistical difference can be shown between the normal and deliberately spaced methods of presentation. It is understood, of course, that "normal" does involve whatever spacing is incident to a person's habitual use of the language, although it never approached the extent of the "spaced" experimental condition. This latter method has the disadvantage of somewhat longer transmission time, a factor that seemed to be of no help transcribing messages of the length employed in this study. On the basis of practical considerations, then the normal rate and phrasing would appear to be the most desirable type of delivery.

Project and Task: 7681-76813 Contract No. AF19(604)-1577
ASTIA No. AD90703

(30)
AFCRC-TN-55-69 June 1956

Moser, Henry M.; Dreher, John J.; O'Neill, John J.; Adler, Sol (Ohio State University)

EFFECTS OF REPEATING THE INITIAL SOUNDS OF WORDS ON THE INTELLIGIBILITY OF AIR MESSAGES

Procedure involved measuring intelligibility of connected speech and isolated words, when spoken with and without stuttering "bounce" at beginning of each word. Conclusion: "intelligibility of air messages might be significantly and importantly increased by the judicious use of the single bounce technique in voice delivery". Recommends further research with operational personnel "specifically trained in using this method".

Project & Task: 7681-76813 Contract No. AF19(604)-1577
ASTIA No. AD90704

(31)
AFCRC-TN-55-70 June 1956

Moser, Henry M.; Dreher, John J.; Oyer, Herbert J. (Ohio State University)

THE RELATIVE INTENSITY OF SOUND AT VARIOUS ANATOMICAL LOCATIONS ON THE HEAD AND NECK DURING PHONATION OF VOWEL SOUNDS

Measurements of sound intensity during vowel phonation are reported for various transducer positions from the larynx to the top of the head, as a step in locating an optimum location for a voice-communication microphone. Individuals (adult males) were chosen to exemplify three major somatotypes: short-stocky, medium, slender. While each subject intoned vowel sounds, the output of a bone-conduction pickup was tape-recorded; sixteen different zones around the head were sampled; twelve vowels were intoned by each subject at each transducer location. Data are reported as percentages of sound-levels secured at the larynx. A rank-order of intensity is established re: anatomical location of pick-up points. The pick-up point of highest intensity is located immediately below the superior thyroid notch of laryngeal prominence.

Project & Task: 7681-76813 Contract No. AF19(604)-1577
ASTIA No. AD90705

(32)
AFCRC-TN-55-73 June 1956

Moser, Henry M.; Dreher, John J.; Adler, Sol (Ohio State University)

NUMBER TELLING OF REPEATED DIGITS, EVEN HUNDREDS AND THOUSANDS

Articulatory efficiency of telling grouped numbers was measured, using following formats: (a) 511=five-double-one or 5111=five-triple-one vs. five-one-one or five-one-one-one; (b) 225=double-two-five or 2225=triple-two-five vs. two-two-five or two-two-two-five; (c) 3446=three-double-four-six or 34446=three-triple-four-six vs. three-four-four-six or three-four-four-four-six. With US talker and listeners, no significant differences were found. Second experiment measured articulation of hundreds and thousands in formats of 100=one-zero-zero vs. one hundred, 1500=one-five-zero-zero vs. one thousand five hundred, 1000=one-zero-zero-zero vs. one thousand. Using US talker and listeners only, apparently significant differences were found favoring single-digit format; however, highest articulation scores did not approach 50 percent correct. S/N=-15 db (white) in all cases. Authors conclude this evidence confirms previous findings.

Project & Task: 7681-76813 Contract No. AF19(604)-1577
ASTIA No. AD105444

(33)
AFCRC-TN-55-74 December 1955

Moser, Henry M.; Dreher, John J.; Harbold, George J. (Ohio State University)

RECOGNITION OF THREE MAGNITUDES OF INTERPHONEMIC TRANSITIONAL INFLUENCE

This study was done to see if recognition of nonsense syllables could be related to the magnitude of interphonemic transitional influence. Monosyllabic nonsense syllables were structured by combining consonants and vowels, with respect to hub location, to effect three discrete magnitudes of transition, namely, (1) Minimum, (2) Medium, and (3) Maximum categories. CV, VC, and CVC syllable forms afforded (a) double representation of each magnitude by each sound combination within each list of syllables, and (b) equal representation of magnitudes as to location of transition with respect to the vowel. Six male speakers recorded the syllables to which 24 trained listeners responded (syllable and speaker orders randomized) in progressively destructive S/N ratios. The ∓3 db S/N ratio results were analyzed. The criterion measure was magnitude recognition irrespective of transition direction. Data were evaluated by triple analysis of variance. Results supported the hypothesis that magnitudes of transition could be differentially recognized and identified. Definite superiority of Minimum transitions over the two greater magnitudes was revealed. Transitions preceding the vowels were superior for both the Minimum and Maximum categories, but there was no significant difference between positions for the Medium magnitudes. It was concluded from the results of this study that: (1) transemes, or discrete magnitudes of interphonemic transitional influence, exist as entities and deserve further consideration in future efforts to delineate the code units of speech; (2) magnitude of transition, direction disregarded, does not provide recognition cues; (3) position of transition shift, with respect to the vowel, is significant for certain magnitudes; (4) direction of shift does not contribute to recognition of magnitude; and (5) transition magnitude might be investigated to determine possible involvement in articulation testing.

Project: 7681 Contract No. AF19(604)-1577
ASTIA No. AD101171

(34)
AFCRC-TN-55-75 November 1955

Francis, Samuel A.; Hawkins, George E. (Francis Associates)

RADAR ROOM LIGHTING: A REPORT ON THE EXPERIMENTAL INSTALLATION AT AN AIR DEFENSE DIRECTION CENTER SITE P-10

Reflections produced by the ambient lighting required for secondary tasks in radar rooms interfere with radar viewing and induce fatigue. Non-specular reflections related to the lighting intensity and specular reflections related to brightness contrasts combine to illuminate the background of the CRT and reduce the contrast between the target and its background. By incorporating the control methods outlined in this paper, a more comfortable visual environment will result. An improvement in operator efficiency and a reduction in fatigue will be possible while using higher lighting levels than before.

Project & Task: 7680-76809 Contract No. AF19(604)-1545
ASTIA No. AD135297

(35)
AFCRC-TN-56-1 February 1956

Pickett, J. M. (Operational Applications Laboratory)

EFFECTS OF VOCAL FORCE ON THE INTELLIGIBILITY OF SPEECH SOUNDS (J. Acoust. Soc. Am., Vol. 28, No. 5, 902-905, Sep 1956)

Measurements were made of the intelligibility of speech heard in noise and produced by different amounts of vocal force. Vocal force ranged from the weakest voiced whisper to a very heavy shout. The results show less than 5 percent deterioration in intelligibility over the range from a moderately low voice to a very loud voice (55 to 78 db in a free field at one m from the lips). Beyond these points intelligibility decreases abruptly and in a linear relation to decibel change in vocal intensity. Listeners' errors are analyzed to determine the effects of the extremes of vocal force on the intelligibility of different parts of the syllable and of different vowels.

Project: 7681
ASTIA No. AD123499

(36)
AFCRC-TN-56-2 April 1956

Klemmer, Edmund T. (Operational Applications Laboratory)

DISCRETE TRACKING IN ONE AND TWO DIMENSIONS

This report concerns human operator performance in two pursuit tracking tasks. In the first task the target appeared in random positions on a linear path and in the second task it took positions on a plane surface. The number of possible positions of the target was varied within each of these tasks. All test runs were self-pacing. Scores are given in terms of tracking rate and amount of information transmitted per second. The maximum information transmission from this type of task is near 4.2 bits/sec. for one-dimensional tracking and 6.6 bits/sec. for two-dimensional tracking.

Project & Task: 7682-76821
ASTIA No. AD102689

(37)
AFCRC-TN-56-3 January 1956

Pollack, Irwin (Operational Applications Laboratory)

IDENTIFICATION OF SOUND LEVEL AND "MATCHING FROM SAMPLE" (J. Acoust. Soc. Am., Vol. 28, No. 3, 412-415, May 1956)

The "identification" and "discrimination" of components of elementary auditory displays are here differentiated in terms of the relative contiguity between the unknown signal and the set of possible signals that may be chosen. Listeners attempted to match arbitrary designations to sound levels of a tone under three conditions of relative contiguity between the unknown sound level and the set of possible sound levels. Significant improvements in matching are associated with increasing contiguity, especially under finely subdivided conditions encompassing a wide range of sound levels.

Project & Task: 7682-76821
ASTIA No. AD106018

(38)
AFCRC-TN-56-4 August 1956

Pollack, Irwin (Operational Applications Laboratory)

EVALUATION OF THE PRINCIPLE OF A NOISE-OPERATED AGC SYSTEM

Noise levels associated with afterburner operation of jet aircraft have become so intense that speech interphone channels must be set at levels which are potentially damaging to the ear. (1) Fortunately, the extremely high noise levels are not continuous in time, but, rather intermittent. It has been suggested (2) that a desirable feature of a speech interphone system, designed to work in extremely high noise fields, would be an automatic gain adjustment, sensitive to the overall noise level. Only at the highest noise levels would the speech channel operate at full gain. At lower noise levels the speech channel could operate at a lower gain. And, thus, the system would not expose personnel continuously to extremely high speech levels. The principle of the system may be termed a "noise-operated" AGC (Automatic Gain Control) interphone system. The present paper merely investigates the feasibility of such a system. No attempt is made to develop the circuitry which could realize such a system, since standard techniques are available for such realization. To the extent that the present tests adequately simulate the performance of a noise-operated AGC system, these tests indicate that the system probably will not result in serious losses of intelligibility, and, under high noise levels near overload of the system, the system may effect significant improvement in intelligibility.

Project & Task: 7684-76841
ASTIA No. AD98816

(39)
AFCRC-TN-56-5 October 1956

Decker, Louis R.; Pickett, J. M. (Operational Applications Laboratory)

VISUAL INDICATION OF SPEECH AS AN AID TO HEARING IT IN NOISE AND BABBLE (J. Acoust. Soc. Am., Vol. 29, No. 1, 150-151, Jan 1957)

Intelligibility tests were conducted to determine whether watching a visual indication of a speech signal would improve its intelligibility under conditions of low signal-to-noise ratio. Noises were tested which had different amounts of similarity to speech. The visual indication was presented on a VU meter. It was found that there is no improvement in intelligibility associated with this type of supplementary visual information.

Project: 7681
ASTIA No. AD98817

(40)
AFCRC-TN-56-7 December 1956

Kryter, Karl D. (Operational Applications Laboratory)

A CRITERION FOR NOISE CONTROL (J. Acoust. Soc. Am., Vol. 29, No. 2, 311, Feb 1957)

The establishment of a criterion for noise in office buildings is a practical and topical endeavor. It is the purpose of this letter to rationalize a possible single criterion that will define acceptable levels of noise. The hope is to have one criterion that will be satisfactory both in respect of interference with speech communication and in respect to to annoyance.

Project: 7681
ASTIA No. AD98828

(41)
AFCRC-TN-56-8 October 1956

Coonan, Thomas J.; Klemmer, Edmund T. (Operational Applications Laboratory)

READING LINEAR SCALES: THE CONTRIBUTION OF EYE MOVEMENTS TO ACCURACY

This study relates a large decrease in scale reading errors found when exposure duration is increased from 0.15 sec. to 0.30 sec. to the occurrence of an eye movement and a second fixation in this time region. Subjects were tested in two scale reading tasks; one allowing only a single eye fixation; the second allowing two or more fixations. Exposure duration was varied from 0.10 sec. to 1.00 sec. in both tasks. The results were as follows: (1) The median time of occurrence of the first eye movement was 0.17 sec. with a range from 0.11 sec. to non-occurrence; (2) The large decrease in the number of scale reading errors when exposure time is increased from 0.15 sec. to 0.30 sec. was confirmed; (3) There is a correlation of 0.92 between the stimulus point presented and the point fixated after the first eye movement. When the exposure duration was short, eye movement directly to the pointer usually occurred after the stimulus had disappeared. In this case the correlation between the stimulus point presented and the point fixated after the first eye movement was 0.87; (4) At exposure durations of 0.15 sec. and less the single fixation and the eye movement tests produce about the same level of accuracy, but the single fixation case shows only slight improvement when the exposure duration is increased to 0.30 sec. and above. The eye movement case shows great improvement when the exposure duration is increased from 0.15 sec. to 0.30 sec.

Project: 7682
ASTIA No. AD98829

(42)
AFCRC-TN-56-11 January 1957

Spieth, Walter (Operational Applications Laboratory)

DOWNWARD SPREAD OF MASKING (J. Acoust. Soc. Am., Vol. 29, No. 4, 502-505, Apr 1957)

Pulsed pure-tone audiograms were obtained in quiet and in the presence of narrow bands of noise centered at 500, 1000, 2000, and 4000 cps and at several levels. The masking produced at lower frequencies was of particular interest: The bands of noise at about 75 db/cy SPL produced from 12-24 db of masking at 100 cps and from 25-40 db of masking at frequencies between about 200 cps and the lower effective limit of the band of noise. This phenomenon contrasts with the fact (briefly reaffirmed in this paper) that a single pure tone of comparable frequency and intensity does not produce appreciable masking at these lower frequencies. It is hypothesized that a band of noise is functionally somewhat equivalent to a bunch of pure tones which when passed through a nonlinear transducer (the ear), produce aural difference tones which elevate the threshold for signals of lower frequency, while a single tone masker would not have this effect. It was found that two pure tones at a spectrum level and at frequencies comparable to the bands of noise do produce aural difference tones (as measured by best beats) of a level which correspond well with the level of lower frequency masking effects in question.

Project: 7681
ASTIA No. AD110056

(43)
AFCRC-TN-56-12 December 1956

Pickett, J. M. (Operational Applications Laboratory)

PERCEPTION OF VOWELS HEARD IN NOISES OF VARIOUS SPECTRA (J. Acoust. Soc. Am., Vol. 29, No. 5, 613-620, May 1957)

The perception of vowels heard in noises of various spectra is analyzed by means of stimulus-response matrices. The stimulus vowels were spoken in PB-word lists and in syllable lists in which the vowels were equally probable. The matrices show shifts in vowel confusions depending on how different noise spectra mask the vowel formants. Vowel duration and intensity are measured and related to vowel perception. Vowel guessing is related to past training.

Project: 7681
ASTIA No. AD110057

(44)
AFCRC-TN-56-50 March 1956

Thwing, Edward J. (Indiana University)

MASKED THRESHOLD AND ITS RELATION TO THE DURATION OF THE MASKED STIMULUS (J. Acoust. Soc. Am., Vol. 28, No. 4, 606-610, Jul 1956)

Previous investigations have shown that the masking capacity of a prolonged auditory stimulus remains constant over its duration in spite of its great diminution in loudness. The experiments which follow were designed to determine the relation between the masked threshold and the duration of the masked stimulus. The results show that (1) within limits, as the duration of a pure tone is increased less noise is required to mask the tone, (2) the magnitude of this effect increases as a function of frequency of the masked tone but appears to be independent of its SPL, and (3) in general, these effects diminish somewhat with practice.

Project & Task: 7681-76811 Contract No. AF18(600)-571
ASTIA No. AD117822

(45)
AFCRC-TN-56-51 March 1956

Egan, James P.; Clarke, Frank R.; Carterette, Edward C. (Indiana University)

ON THE TRANSMISSION AND CONFIRMATION OF MESSAGES IN NOISE (J. Acoust. Soc. Am., Vol. 28, No. 4, 536-550, Jul 1956)

In several experiments, the restrictions imposed upon the communication process by an articulation test were relaxed by increasing the number of events in the communication sequence. A communication event is the transmission of a message from the source to the receiver followed by the return of a message (correct or incorrect) from receiver to source for confirmation. Although both source and receiver serve as talker and listener, the relation between them is asymmetric. Since the source knows the original message, he must accept or reject the message sent back to him according to some criterion. Various types of communication events arise depending upon (1) whether or not the receiver correctly hears the message, and (2) whether or not the source confirms the message returned by the receiver. The various probabilities associated with these events are investigated as a function of speech-to-noise ratio. The behavior of the source is examined in terms of the relation between the two conditional probabilities associated with a correct and with an incorrect confirmation. If each message is sent repeatedly until all are confirmed, a sequence of communication events is generated. A simple mathematical model accurately describes this process.

Project & Task: 7681-76814 Contract No. AF18(600)-571
ASTIA No. AD117821

(46)
AFCRC-TN-56-52 May 1956

Egan, James P.; Gerjuoy, Herbert; Thwing, Edward J. (Indiana University)

CORRELATION BETWEEN ARTICULATION SCORES FOR SPEECH MASKED BY NOISE AND FOR SPEECH MASKED BY SPEECH

The purpose of the present series of studies was to determine the degree of relationship between the ability to receive speech in a background of similar speech and the ability to receive speech in a background of noise. The product-moment correlation obtained by articulation tests between these two abilities was of the order of .50.

Project & Task: 7681-76814 Contract No. AF18(600)-571
ASTIA No. AD110348

(47)
AFCRC-TN-56-53 October 1956

Marill, Thomas M. (Massachusetts Institute of Technology)

DETECTION THEORY AND PSYCHOPHYSICS

Part I: Traditional psychophysical models and Tanner and Swets' model are critically examined. Some of the weaknesses of these models are found to be eliminable by a more sophisticated analysis in terms of detection theory. Accordingly, psychophysical methods are re-examined and the two-category forced-choice technique is found to be particularly advantageous on theoretical grounds. Application of detection theory to the problem of auditory masking with gaussian noise as measured by this forced-choice technique leads to the mathematical derivation of the theoretical ("ideal detector") psychophysical function for this situation. Part II: Experiments using the forced-choice method with auditory signals masked by broadband gaussian noise are reported. The aim of these experiments is to determine the extent to which and the manner in which subjects differ from the "ideal detector" of detection theory. It is found that, except for being approximately 13 db less sensitive, subjects behave very much like the ideal detector—that is, in accordance with the mathematical predictions of Part I—when the signals are pure tones. Results with signals consisting of two-component tones require a somewhat enlarged model; such a model is developed.

Project & Task: 7682-76826 Contract No. AF18(600)-1219
ASTIA No. AD110092

(48)
AFCRC-TN-56-54 July 1956

Moser, Henry M.; Dreher, John J. (Ohio State University)

PRELIMINARY TESTS OF AIR DEFENSE COMMAND PROCEDURE WORDS

Purpose: to make preliminary test of certain high-frequency air defense procedure words and some possible alternates when spoken by American, French and Danish speakers to American listeners. Stimulus materials: 6 ADC key words (Track, At, Range, Course, Objects, Speed) + 36 other terms currently in ADC (CONAD 55-1) use or being considered as alternates for terms in use. Lists of these 42 words were recorded by talkers and played to American listeners at S/N (white noise)=5 db, and at S/N ("voice babble")=5 db; also in quiet. Talkers were: 2 general American males; English-speaking French, 1 male and 1 female; English-speaking Spanish, 1 male and 1 female. Listeners were required to write down the words as presented; listener responses were scored for errors. Conclusions: under quiet receiving conditions, reception of the procedure words was "virtually perfect" no matter by what nationality they were read. Both types of noise (white and voice-babble) "seriously affected reception". White noise at a given S/N ratio is more deleterious to intelligibility of these words than is voice-babble at the same S/N. American speakers were more intelligible (to American listeners) than were the other nationalities, under all conditions. The operational tag-words (Target, At, Range, Course, Objects, Speed) were received significantly poorer than the other operational terms.

Project: 7681 Contract No. AF19(604)-1577
ASTIA No. AD106780

(49)
AFCRC-TN-56-55 August 1956

Moser, Henry M.; Dreher, John J.; Oyer, Herbert; O'Neill, John J. (Ohio State University)

EFFECTS OF SEQUENCE UPON THE RECEPTION OF RELATED AND NONRELATED MESSAGE ELEMENTS

This study has attempted to make a basic attack on the problem of the optimum word ordering of typical air messages. The starting point, that of order effect on two- and three-element call-signs which may be composed of related or nonrelated words, opens the door for examination of the longer, more complicated relationships of operational messages. The first point of investigation, namely, the effects of sequence on the loudness of words in pairs, compared common words with their own time-ordered reversals and showed that (a) the latter element of a pair is heard as louder; (b) this tendency is increased when the second element is more familiar than the first, decreased when it is less familiar, and (c) this loudness difference amounts to approximately two decibels. The second phase of the study, comparing the effects of sequence on free forms of common English spondees and couplets, indicated that (a) listeners, when aurally presented the first half of a spondee, could reproduce the whole word with more success than when presented only with the latter half, and (b) listeners, presented with couplets (two commonly connected free forms) could identify the pair more successfully when they were in the common (expected) order than when they were in the uncommon (unexpected) order, even though the intelligibility of the individual of the free forms were equal. The third phase, considering syntactically related two-unit call-signs and nonsyntactically related three-unit call-signs, showed that (a) when both the nouns and modifiers of the two-unit ensembles are small (in this case four and eight words, respectively), either the call-name or its adjective may come first unless the former has relatively high confusability, in which case the (English) habitual order of adjective-noun is more effective for identifying the pair, (b) the intelligibility of a sequence of three unrelated words, as used in the three-unit calls, is independent of their order of occurrence, and (c) the alerting values of the sequences are equivalent unless the call-name involved is confusable, in which the alerting value of sequences containing this noun is diminished.

Project & Task: 7681-76813 Contract No. AF19(604)-1577
ASTIA No. AD111682

(50)
AFCRC-TN-56-56 August 1956

Egan, James P.; Clarke, Frank R. (Indiana University)

SOURCE AND RECEIVER BEHAVIOR IN THE USE OF A CRITERION (J. Acoust. Soc. Am., Vol. 28, No. 6, 1267-1269, Nov 1956)

A listener in an articulation test is confident of some of his responses and dubious about others. On the basis of this fact, it is reasonable to require that a receiver decide whether or not his response is correct. If he adopts various criteria from test to test, a receiver operating characteristic may be obtained which will be one way of describing quantitatively this type of behavior. The curve showing the confirming and rejecting behavior of the receiver is compared to that of the source using the same test materials and the same speech-to-noise ratio.

Project & Task: 7681-76814 Contract No. AF18(600)-571
ASTIA No. AD122550

(51)
AFCRC-TN-56-57 October 1956

Moser, Henry M.; Dreher, John J. (Ohio State University)

OPERATIONAL TESTS OF MINIATURE MICROPHONES AND RECEIVERS

On the basis of this and other tests it is concluded that different kinds of flying assignments make any one headset-microphone combination a difficult, if not impossible ideal. Whereas jet personnel may be satisfied with some sort of earmuff and associated headset due to their habitual use of head protection, equipment satisfactory for their use is entirely unsatisfactory for duty in hot, humid climates at comparatively low altitudes. The operational test of the ear and bone units used as microphones indicated performance equal to that presently used, with considerable relief from a point of view of weight and convenience. The ear insert functioned satisfactorily as a receiver as well. It should be pointed out here that during these tests the ear microphone was furnished with the protection of an ear muff, a feature that would not be acceptable in operational use. Some modifications of the ear microphone have already been effected to increase the signal strength several db, a factor that may make it possible to both send and receive with the same unit without the use of any muff protection. The use of the bone transducer as a receiver without some isolation of the ears does not seem feasible. Statistical comparisons of scores of tests on PB words under the conditions of these flights indicated a significant difference in intelligibility in favor of the present M-33 microphone, although the mean difference in test scores was comparatively small.

Project & Task: 7681-76813 Contract No. AF19(604)-1577
ASTIA No. AD98819

(52)
AFCRC-TN-56-58 October 1956

Moser, Henry M.; Dreher, John J.; O'Neill, John J.; Oyer, Herbert J. (Ohio State University)

COMPARISON OF MOUTH, EAR, AND CONTACT MICROPHONES

A first-order-differential noise cancelling microphone (RCA M-33/AIC), and selected ear, throat, and bone transducers were used for comparison studies in various recording and listening conditions. The noise cancelling microphone was used as the control microphone and two simultaneous recordings were made for each of three recording conditions (quiet, 100 db and 111 db noise) for each of the four comparison microphones. The recordings made by trained speakers pronouncing Harvard PB words in quiet and noise were presented to trained listeners in quiet and noise. Under quiet listening conditions the M-33 microphone was generally superior to the other microphones, although the performance of the ear transducer and the bone conduction oscillator was similar to that of the M-33 under quiet recording conditions. The results under noise listening conditions were more tenuous but they indicated that the ear transducer was superior under all three recording conditions with one of the throat microphones equalling its performance under the two noise recording conditions. A variation of the noise-cancelling microphone mounted in an oxygen mask was compared to the ear transducer and the results were similar to those obtained in the M-33 comparison study. A second experimental study utilized an improved form of the ear transducer and the M-33 microphone. Recording and listening conditions were somewhat similar to those employed in the first study. Under quiet listening conditions the performance of the M-33 microphone excelled or equalled that of the ear transducer. In ambient room noise listening conditions, performance of the M-33 was clearly superior. Under conditions of in-line noise the ear transducer was superior or equal to the M-33 for two of the three recording conditions. However, the M-33 was superior to the 115 db noise recording conditions.

Project & Task: 7681-76813 Contract No. AF19(604)-1577
ASTIA No. AD98820

(53)
AFCRC-TN-56-59 October 1956

Moser, Henry M.; Dreher, John J.; O'Neill, John J.; Oyer, Herbert J. (Ohio State University)

LISTENER RESPONSE SET TO VARIOUS TEST FORMS

This report is confined to some considerations of subjects' reactions to the physical setup of answer sheets for several kinds of test blanks in current use in speech reception investigations. The subjects who took the tests received no auditory stimuli whatsoever; they were simply asked to make the appropriate choices required by the particular answer sheet at hand. On the basis of experimental evidence it is concluded: (1) The first two items of a two-alternative test (e.g. true-false) showed nonchance response "set". The remaining items showed a chance distribution of selections. (2) When the digit 1 or 2 is used to indicate the choice between two alternatives, the digit 1 is used significantly more often than 2. (3) Neither two-nor three-alternative cross-out items were conducive to a chance distribution of selections. (4) Four-, five-, six-, seven-, and eight- alternative crossout items showed a chance distribution of selections, with horizontal and vertical arrays equally effective. (5) With the numerical selection method, only the range of seven points offered chance distributions. Ranges of 5, 6, and 8 through 14 showed distributions of selections displaced toward the high end of the scale. (6) The seven-point range laid out horizontally on a physical scale produced a chance distribution of interval selections. (7) The distribution of selections accomplished by the numerical entry method and the cross-out method were significantly different for the two- and three- alternative items, no different for the two methods for items offering four to seven alternatives. (8) Seven-alternative items, with available choices laid out in vertical columns and indicated by checking boxes placed in front of the choices, produced a chance distribution of selections.

Project & Task: 7681-76813 Contract No. AF19(604)-1577
ASTIA No. AD98821

(54)
AFCRC-TN-56-60 June 1957

Miller, George A. (Harvard University)

SOME EFFECTS OF INTERMITTENT SILENCE (Amer. J. Psychol., Vol. 70, No. 2, 311-313, Jun 1957)

This is a statistical linguistic study of the random hitting of keys of a typewriter with certain constraints.

Project: 7682 Contract No. AF33(038)-14343
ASTIA No. AD98822

(55)
AFCRC-TN-56-61 November 1957

Miller, George A.; Beebe-Center, J. C. (Harvard University)

SOME PSYCHOLOGICAL METHODS FOR EVALUATING THE QUALITY OF TRANSLATIONS

The present article attempts to survey some of the possible methods of measuring the extent to which a translation preserves the exact meaning of the original. One can ask the opinion of several competent judges, or given a translation of granted excellence, one can compare test translations with this criterion by a variety of statistical indices, or a person who has read only the translation may be required to answer questions based on the original. The characteristic advantages and disadvantages of each method are illustrated by examples.

Project: 7682 Contract No. AF33(038)-14343
ASTIA No. AD98823

(56)
AFCRC-TN-56-63 1956

Miller, George A. (Harvard University)

THE HUMAN LINK IN COMMUNICATION SYSTEMS (Proceedings of the National Electronics Conference, Vol. XII, 1956)

A discussion of communication, psychology, information theory and linguistics. Thesis is that finding out more about man, is the road to providing channels of communication that are maximally efficient.

Project: 7682 Contract No. AF33(038)-14343
ASTIA No. AD98825

(57)
AFCRC-TN-56-64 August 1956

Newman, Edwin B. (Harvard University)

STATISTICAL METHODS IN PHONETICS (Pub. under auspices of Comité International Permanent De Linguistes by the North Holland Pub. Co., 28 Aug 1956)

A warning is sounded to the phonetician in the proper use of statistics in his field. A large model is assumed which requires that events be placed in categories and counted. Before statistical procedures may be applied such events must be judged and counted by the expert in phonetics or linguistics, who is also responsible for an adequate sampling. Certain relevant statistical techniques are discussed.

Project: 7682 Contract No. AF33(038)-14343
ASTIA No. AD98826

(58)
AFCRC-TN-56-65 January 1957

Egan, James P. (Indiana University)

MONITORING TASK IN SPEECH COMMUNICATION (J. Acoust. Soc. Am., Vol. 29, No. 4, 482-489, Apr 1957)

Some communication situations involve several noisy channels, and only certain ones of these carry relevant information to a given communication operator. The operator must receive and identify a restricted number of different messages, and he must ignore others. The performance of the listener in this situation will depend both on the discriminability of the messages and on the listener's criterion for accepting his response as correct or rejecting it as incorrect. The present paper gives a quantitative description of the monitor's behavior in terms of the operating characteristic and the articulation-criterion function. The results of two experiments are reported. In one of these, the confusion matrices for the various sets of messages were also determined.

Project & Task: 7684-76841 Contract No. AF18(600)-571
ASTIA No. AD98827

(59)
AFCRC-TN-56-66 October 1956

Licklider, J. C. R.; Guttman, Newman (Massachusetts Institute of Technology)

MASKING OF SPEECH BY LINE-SPECTRUM INTERFERENCE (J. Acoust. Soc. Am., Vol. 29, No. 2, 287-296, Feb 1957)

Two series of intelligibility tests were conducted. In the tests, speech was presented against a background of interference. The line-spectrum interference consisted of from 4 to 256 sinusoids, superposed in a linear adder. Three different spacings of the components in frequency, and several different distributions of power among the components, were studied. Tests with continuous-spectrum random noise were made for comparison. The overall interference power required to reduce intelligibility to a given level decreases as the number of components in the interference increase. The drop is about 10 db in the decade from 4 to 40 components. Beyond 40, there is much less change. Even 256 components, however, mask measurably less effectively than random noise of equivalent power in the band 200-6100 cps. For a given number of components, the line-spectrum interference most detrimental to intelligibility has the same number of components in each frequency band of equal contribution to intelligibility, and its components are uniform in amplitude. The bearing of these findings on the theory of intelligibility and on procedures for predicting intelligibility from physical parameters is discussed.

Project & Task: 7682-76826 Contract No. AF18(600)-1219
ASTIA No. AD98831

(60)
AFCRC-TN-56-67 February 1958

Carterette, Edward C. (Indiana University)

MESSAGE REPETITION AND RECEIVER CONFIRMATION OF MESSAGES IN NOISE (J. Acoust. Soc. Am., Vol. 30, No. 9, 846-855, Sep 1958)

A receiver may be required to decide whether the message he has recorded is or is not the message actually received. The degree of certainty needed for confirmation (the criterion) may be controlled by instructions. A sequence of decisions is generated by repeatedly sending each of a set of messages until the set is confirmed. A simple stochastic model assumes that the probability of confirmation, p_y, is constant over such a sequence. If N messages are sent, the expected number confirmed after the first n presentation is $E(n)=N[1-(1-p_y)^n]$. Two experimental tests were (1) of the constancy of p_y by noting whether the equation for E(n) holds, and (2) of the constancy of p_y's three component probabilities: The probabilities of correct reception, correct confirmation, and incorrect confirmation. Receivers listened under two noise conditions to sets of several hundred messages each. Each message was immediately repeated until confirmed. Estimates of p_y and of the component probabilities were made from proportions of correct and incorrect responses. The data show that the assumption of constant p_y yields a very accurate description of the process, and justify the more basic assumption that p_y's three components are constant over repeated trials.

Project & Task: 7684-76844 Contract No. AF18(600)-571
ASTIA No. AD98834

(61)
AFCRC-TN-56-70 March 1958

Miller, James D. (Indiana University)

TEMPORARY HEARING LOSS AT 4000 C.P.S. AS A FUNCTION OF THREE-MINUTE EXPOSURE TO A NOISE OF UNIFORM SPECTRUM LEVEL (Laryngoscope, Vol. LXVIII, No. 3, 660-671, Mar 1958)

This report describes the temporary hearing loss of subject exposed to three minute exposure of white noise. Length of temporary hearing loss varied somewhat from subject to subject. Curves of temporary hearing loss in decibels are related to noise intensity.

Project & Task: 7684-76841 Contract No. AF18(600)-571
ASTIA No. AD110052

(62)
AFCRC-TN-56-71 February 1958

Miller, James D. (Indiana University)

TEMPORARY THRESHOLD SHIFT AND MASKING FOR NOISE OF UNIFORM SPECTRUM LEVEL (J. Acoust. Soc. Am., Vol. 30, No. 6, 517-522, Jun 1958)

This experiment was designed to test the hypothesis that differences in the effective noise level from one critical band to the next can account for the typical audiogram showing the temporary threshold shift which results from an exposure to noise of uniform spectrum level. For equal masking, or $(B+K - B_0)$, the greatest losses were found at the highest frequencies and the smallest losses at the lowest frequencies. However, the hypothesis implied that for equal masking all frequencies would show equal losses. Further analysis revealed that when the data for temporary threshold shift were plotted against the quantity $(B+2.7K-B_0)$, the points for all test-tone frequencies fell on a common curve.

Project & Task: 7684-76841 Contract No. AF18(600)-571
ASTIA No. AD110053

(63)
AFCRC-TN-56-72 February 1957

Clarke, Frank R. (Indiana University)

CONSTANT-RATIO RULE FOR CONFUSION MATRICES IN SPEECH COMMUNICATION (J. Acoust. Soc. Am., Vol. 29, No. 6, 715-720 Jun 1957)

Three experiments are reported which give support to an empirical rule which may be used for predicting the entries in a closed confusion matrix for any subset of items drawn from a master set of items with a known confusion matrix. This rule, the constant-ratio rule, states that the ratio between any two entries in a row of a submatrix is equal to the ratio between the corresponding two entries in the master matrix. For this statement of the rule it is assumed that the only variables which differ systematically in obtaining the two matrices are the different sets of messages and the allowable responses. This is an empirical rule which was formulated after examination of three 6 x 6 master matrices for CV's (consonant-vowel syllables) and six 3 x 3 submatrices. Two more experiments using monosyllables and digits were then conducted to test the rule further. Although no direct experimental evidence is reported, the use of the constant-ratio rule for predicting a master matrix given some of its possible submatrices is discussed.

Project: 7682 Contract No. AF19(604)-1962
ASTIA No. AD110058

(64)
AFCRC-TN-56-73 January 1957

Moser, Henry M.; Dreher, John J.; Wolfe, Susan M. (Ohio State University)

CONTRIBUTION OF STANDARD SEQUENCE TO AN AIR DEFENSE TASK

Typical Air Defense surveillance messages were read with elements in standard order and in random order to two groups of listeners. Each group practiced logging data in one particular type of sequence for seven hour-long training periods, at which time the standard and random orders were interchanged to assess the performance of listeners on an unfamiliar type of presentation. A final proficiency test consisting of extremely rapid telling of messages in regular order was administered to both groups to evaluate the two types of training. Results indicated: (1) When using standard vocabulary and one type of message, the message items may be presented in different sequence to trained groups without seriously affecting reception. (2) Initial results produced better intelligibility scores for the standard-ordered material. However, training appeared to negate this original advantage. (3) Groups trained in standard and random sequence, respectively, showed no significant difference when the presentation method was interchanged. (4) Groups trained in standard and random sequence, respectively, showed no significant difference when subjected to speed tests of standard-ordered messages.

Project & Task: 7681-76813 Contract No. AF19(604)-1577
ASTIA No. AD110059

(65)
AFCRC-TN-56-74 May 1957

Moser, Henry M.; Dreher, John J.; O'Neill, John J. (Ohio State University)

THE MASKING OF ENGLISH WORDS BY PROLONGED VOWEL SOUNDS

One hundred and ten monosyllabic words selected from the Thorndike list of 1000 most frequently occurring words in English to represent equally each of 10 vowels were presented to 300 American listeners in an articulation test. Also tested were 72 spondee words, half selected from those in use in audiological tests and half from those in frequent use in air traffic control, to further represent the same vowel sounds. Masking of the stimuli was accomplished by separately recording each of nine prolonged vowels intoned by a trio of male voices. Results indicate that vowels of equal sound pressure levels differ considerably in masking effectiveness, that words containing a specific vowel are not masked optimally by the same vowel, and that spondees are masked by prolonged vowels in the same rank order as the monosyllables. Prolonged vowel sounds with relatively high concentration of energy between 700 and 1000 cps are most effective as masking agents. Rank order correlation of observed masking effectiveness with masking effectiveness predicted by the Strassberg method is .52, the Beranek method is .59, and by the Pickett-Kryter method, .69. Some observations on resistance of words to masking are made in relation to phonemic transition areas within words.

Project & Task: 7681-76813 Contract No. AF19(604)-1577
ASTIA No. AD110060

(66)
AFCRC-TN-57-1 September 1957

Klemmer, Edmund T. (Operational Applications Laboratory)

A FURTHER STUDY OF INFORMATION TRANSMISSION WITH MATRIX PATTERNS

The present experiment samples from a class of 1,048,576 different patterns, this being the number of dot patterns that can be generated on a 4 by 5 matrix if all numbers of dots are allowed. Several different methods of approximating the information transmission are employed with encouraging results.

Project & Task: 7682-76821
ASTIA No. AD110066

(67)
AFCRC-TN-57-2 September 1957

Pollack, Irwin.; Pickett, J. M. (Operational Applications Laboratory)

EFFECT OF NOISE AND FILTERING ON SPEECH INTELLIGIBILITY AT HIGH LEVELS (J. Acoust. Soc. Am., Vol. 29, No. 12, 1328-1329, Dec 1957)

The effects of high sound levels on wide-band speech in noise roughly parallel the effects of high levels on filtered speech. The Articulation Index (AI) concept encompasses both findings if it is assumed that the effect of high sound levels is to produce an effective change in AI.

Project & Task: 7684-76841
ASTIA No. AD110080

(68)
AFCRC-TN-57-3 September 1957

Pollack, Irwin; Pickett, J. M. (Operational Applications Laboratory)

STEREOPHONIC LISTENING AND SPEECH INTELLIGIBILITY AGAINST VOICE BABBLE (J. Acoust. Soc. Am., Vol. 30, No. 2, 131-133, Feb 1958)

The utilization of a particular form of stereophonic information was studied with respect to the intelligibility of a single speech source heard in the presence of a voice babble of other speakers. The reception of monosyllabic words, presented against a babble of 1, 2, 4, or 7 talkers, was compared under two listening conditions: (1) In the stereophonic listening condition, one set of background talkers was presented to one earphone, another set of background talkers was presented to the other earphone, and the test words were presented binaurally, in phase; (2) In the control listening condition, only a single set of background talkers, and the test words, were presented to a single ear. The stereophonic advantage, for 50 percent word intelligibility, ranged from 12 db with 1 background voice per channel to 5.5 db with 7 background voices per channel.

Project & Task: 7681-76814
ASTIA No. AD110081

(69)
AFCRC-TN-57-4 December 1957

Pollack, Irwin; Pickett, J. M. (Operational Applications Laboratory)

INTERAURAL EFFECTS UPON SPEECH INTELLIGIBILITY AT HIGH NOISE LEVELS (J. Acoust. Soc. Am., Vol. 30, No. 4, 293-296, Apr 1958)

The role of interaural effects upon speech intelligibility was examined at high noise levels. Over a wide range of conditions, a "mixed" listening condition (speech and noise to one ear and noise alone to the other ear) produced substantially lower intelligibility scores than monaural or binaural presentation of both speech and noise. The results are interpreted in terms of the interaction between the intelligibility of speech cross-conducted to the other ear and the apparent localization in space of the speech and noise.

Project & Task: 7684-76841
ASTIA No. AD110083

(70)
AFCRC-TN-57-5 September 1957

Pollack, Irwin; Tecce, Joseph (Operational Applications Laboratory)

STANDARDIZED COMMUNICATIONS AND MESSAGE RECEPTION (J. Acoust. Soc. Am., Vol. 30, No. 1, 62-64, Jan 1958)

The reproduction of messages, selected from defined informatlon sources, was studied ln a multichannel listening task. Standardization of message procedures was controlled independently of standardization of message nomenclature. It is shown that the standardlzation of procedures or nomenclature is an effective determinant of message reproduction. And, the joint standardization of both nomenclature and procedure is more effective than either alone.

Project & Task: 7682-76821
ASTIA No. AD110084

(71)
AFCRC-TN-57-6 November 1957

Pickett, J. M. (Operational Applications Laboratory)

LIMITS OF DIRECT SPEECH COMMUNICATION IN NOISE (J. Acoust. Soc. Am., Vol. 30, No. 4, 278-281, Apr 1958)

Person-to-person tests of sentence intelligibility were carried out in low frequency and white noise at noise levels ranglng from 85 to 118 db. Talkers attained shouting levels of vocal effort but the maximum tolerable noise levels for 90 percent sentence intelligibility and 1 m between talker and listener were estimated to be 95 db for white noise and 105 for low-frequency noise.

Project & Task: 7684-76842
ASTIA No. AD110096

(72)
AFCRC-TN-57-7 November 1957

Spieth, Walter; Trittipoe, Wlliam J. (Operational Applications Laboratory)

TEMPORARY THRESHOLD ELEVATION PRODUCED BY CONTINUOUS AND "IMPULSIVE" NOISES (J. Acoust. Soc. Am., Vol. 30, No. 6, 523-527, Jun 1958)

Three experiments compared the amounts of temporary threshold elevation resulting when a given total amount of nolse energy was presented to the ear in the form of repeated, short, intense bursts, and in the form of continuous noise (of much lower maximum intensity). Several patterns of noise bursts were tested, as well as continuous noise. One-millisecond noise bursts and continuous noise, of 20 minute duration, were tested most extenslvely. The most severe impulsive noise tested consisted of 1-msec bursts every 10 msec for 20 min., with a burst SPL of 127 db or long-time-average level of 117 db. It appeared quite conclusively that 1-msec bursts of noise have considerably less effect than the equivalent amount of continuous energy on thresholds at 3000, 4000, 6000, and 8000 cps. Noise bursts of 10 msec, 100 msec, and 1 sec length were tested less extensively; it appears that they would cause no more threshold elevatlon than would the equlvalent amount of continuous noise.

Project & Task: 7684-76843
ASTIA No. AD146754

(73)
AFCRC-TN-57-8 November 1957

Decker, Louis R.; Pollack, Irwin (Operational Applications Laboratory)

CONFIDENCE RATINGS AND MESSAGE RECEPTION FOR FILTERED SPEECH (J. Acoust. Soc. Am., Vol. 30, No. 5, 432-434, May 1958)

The statistical decision model, which has achieved outstanding success in describing the detection of signals in noise was applied to the reception of fllltered speech. A confidence rating was added to the articulation test procedure in order to obtain additional information about the listener's criterion of message acceptance and message rejection of filtered speech. The relation between correct confirmations and false alarms--the Receiver Operating Characteristic--obtained with filtered speech corresponds with that typically obtained with noise interference. It is suggested that the "noise" of the decision model may be extended to a wide range of operations which perturb the signal.

Project & Task: 7682-76821
ASTIA No. AD146755

(74)
AFCRC-TN-57-9 December 1957

Trittipoe, William J. (Operational Applications Laboratory)

TEMPORARY THRESHOLD SHIFT AS A FUNCTION OF NOISE EXPOSURE LEVEL (J. Acoust. Soc. Am., Vol. 30, No. 4, 250-253, Apr 1958)

Under special conditions, numerous investigators have observed that, when duration of exposure is held constant, a greater temporary threshold shift (TTS) may occur after exposure to a lower sound level than after exposure to a higher sound level. However, at least after a short recovery interval, it would be reasonable to expect that TTS following exposure to higher sound levels would be an increasing function of the exposure level. In the present study TTS was measured continuously with a Békésy-type audiometer at 4000 and 6000 cps for 10 min following a 3-min exposure to a thermal noise. Five different noise levels, ranging in 5-db steps from 108 to 128 db in SPL, were used. Among nine ears tested, twice on each condition, only one ear showed a pattern of decreasing TTS with an increased noise exposure level at both measuring frequencies.

Project & Task: 7684-76843
ASTIA No. AD146756

(75)
AFCRC-TN-57-50 February 1957

Creelman, C. Douglas (Harvard University)

CASE OF THE UNKNOWN TALKER (J. Acoust. Soc. Am., Vol. 29, No. 5, 655, May 1957)

This report describes an articulation test. Average scores for listeners to individual talkers was only 7 percent greater than the average score when two or more talkers were used. It appears, therefore, that the adjustments we make in our perceptual system when listening to different talkers are relatively minor. This result would seem to imply that considerable improvement can be expected in automatic recognition when the information-bearing aspects of speech are better known.

Project & Task: 7682-76822 Contract No. AF33(038)-14343
ASTIA No. AD110062

(76)
AFCRC-TN-57-51 August 1957

Moser, Henry M.; Dreher, John J.; Schwartzkopf, Lewis J. (Ohio State University)

PHRASEOLOGY OF INTERNATIONAL LANGUAGE OF THE AIR (SENTENCE FORM)

Implications of the International Civil Aviation Organization State Letter AN 7/38-514 in regard to changes in currently authorized radio-telephone procedures are discussed. A method of testing comprehension of air messages is described, and the results for foreign and American listeners are reported along with comments of a seminar composed of foreign pilots and language instructors of the Air Force Language School. Tests indicated that the recommended full-sentence forms and the present structures in use are equivalent for conveying the meaning of air messages to both American and foreign airmen. The consensus of the seminar indicated a definite preference for the brevity and clarity of the presently authorized telegraphese structures, and opposition to the addition of words and expansion of sentence structures. Specific suggestions on the choice of words and the sentence structures are included.

Project & Task: 7681-76813 Contract No. AF19(604)-1577
ASTIA No. AD110067

(77)
AFCRC-TN-57-52 July 1957

Dreher, John J.; O'Neill, John J. (Ohio State University)

EFFECTS OF AMBIENT NOISE ON SPEAKER INTELLIGIBILITY FOR WORDS AND PHRASES (J. Acoust. Soc. Am., Vol. 29, No. 12, 1320-1323, Dec 1957)

The Lombard, or voice reflex, effect results in speech with characteristics different from those of speech that is normally produced. This change of characteristics can be demonstrated as an effective way to combat noise interference during reception. It also demonstrates the advisability of control of the production of speech by the speaker himself, in addition to that offered by equipment, during audiological evaluations. Fifteen naive speakers read words and sentences while noise was being delivered to their headsets. There were five noise conditions. Their speech was recorded, with the noise being kept out of the recording channel, and then limited. Noise was then added to the recording in such a way as to produce a constant speech-to-noise ratio. The result was played to 200 American listeners. Results indicate that at a constant speech-to-noise ratio of reception speech produced by a talker with masking noise in his ears becomes more intelligible as the masking level rises to a given value. The change in intelligibility throughout the range investigated suggests an application to audiological testing as well as a device for use in voice communication.

Project & Task: 7681-76813 Contract No. AF19(604)-1577
ASTIA No. AD110068

(78)
AFCRC-TN-57-53 June 1957

Clarke, Frank R.; Anderson, Clint D. (Indiana University)

FURTHER TEST OF THE CONSTANT-RATIO RULE IN SPEECH COMMUNICATION (J. Acoust. Soc. Am., Vol. 29, No. 12, 1318-1320, Dec 1957)

The use of the constant-ratio rule to predict the confusion matrices for each of two five-item subsets given the confusion matrix for a ten-item master set is tested with naive subjects. Ninety percent of the predicted cell entries (expressed as proportions) deviated by less than 0.05 from the obtained cell entries. The predicted articulation score for the first subset was 67.9%, and the obtained articulation score was 68.9%. For the second subset the predicted and the obtained articulation scores were 78.4% and 82.6%, respectively.

Project & Task: 7684-76841 Contract No. AF19(604)-1962
ASTIA No. AD110069

(79)
AFCRC-TN-57-54 July 1957

Moser, Henry M.; Dreher, John J.; Schwartzkopf, Lewis, J. (Ohio State University)

AN EAR-MOUTH VOICE TRANSDUCER

An ear-mouth voice transducer has been experimentally fabricated. The device operates with sufficiently good signal-to-noise ratio to be used without circumaural protection in the noise fields generated operationally by present Air Force propeller-driven aircraft. A small magnetic insert transducer coupled to a custom-fitted earmold, a short length of aluminum tubing, and a small plastic receptacle forming an acoustic link with mouth-emitted speech operates both as a microphone and as a receiver. Spectral measurements of selected vowels and consonants are presented, along with pickup characteristics of ambient white noise. Articulation results with Harvard PB words and trained laboratory listeners show that words recorded in 90 db of ambient white noise are identified equally well with the Air Force M/33-A1C and experimental microphones fabricated by this laboratory. The comparatively small margin of difference between the two at levels of 100 and 106 db indicates that they might be operationally equivalent. Sentences recorded in 115 db of engine noise resulted in almost perfect scores with both the M-33 and the ear-mouth device. Both civilian and military flight operations carried on with the experimental microphone-receivers resulted in satisfactory communications. A summary of opinions by chief instructor pilots at the West Palm Beach (MATS) AFB is presented. Also recorded are some suggestions for possible improvement of the device for future development.

Project & Task: 7681-76813 Contract No. AF19(604)-1577
ASTIA No. AD110071

(80)
AFCRC-TN-57-55 October 1957

Moser, Henry M.; Dreher, John J.; Oyer, Herbert J.; O'Neill, John J.; Schwartzkopf, Lewis, J. (Ohio State University)

EXPECTATION IN MESSAGE RECEPTION

Listening panels of foreign and American airmen were given printed lists of monosyllablic words, polysyllabic words, and air traffic instructions. Their task was to decide whether these printed messages agreed or disagreed from correspondingly numbered aural messages which were presented in noise. Results indicated that under good listening conditions, both foreign and American listeners were influenced by suggestion regarding the probable amount of message agreement and disagreement. Listeners could err by (1) failing to identify matching signals, and (2) failing to discriminate between disagreeing signals. In all conditions of expectation it was more difficult for subjects to determine when the messages were dissimilar. The magnitude of both error types tended to increase with the length of the message; sentences were more subject to error than polysyllabic words, and polysyllables more than monosyllables. Apparently, the criteria of listener judgment shifted when the subject was concerned with different lengths of message. Foreign airmen, although more experienced in listening to radio-telephone messages, showed more errors in each type of test material. American airmen, although less experienced in listening to radio-telephone messages showed fewer errors in each type of test material than did foreign airmen, suggestive of the effect of secondary language influence. This hypothesis is further substantiated by the greater accuracy in both discrimination and identification demonstrated by foreign students advanced in English over those classed as basically proficient in the language. Expectation of messages is seen as a measurable factor operating in a communication link.

Project & Task: 7681-76813 Contract No. AF19(604)-1577
ASTIA No. AD110072

(81)
AFCRC-TN-57-58 October 1957

Licklider, J. C. R.; Christman, Raymond J.; Guttman, Newman (Massachusetts Institute of Technology)

ON JAMMING SPEECH COMMUNICATIONS WITH COHERENTLY AMPLITUDE-MODULATED INTERFERENCE

Audio tests were conducted to determine the effectiveness of two schemes for jamming speech communication while still permitting read-through by the jammer. Both schemes involve superposing upon the speech a number of slowly modulated sinusoids. In the tests, 6, 11, and 16 sinusoids, with frequencies selected for maximal interfering effect, were used. In the first scheme, the sinusoids were modulated in such a way as to make the interference strong in the time-frequency areas in which the speech is strong and weak in the areas in which the speech is weak. That scheme proved not to be effective for jamming because the "interference" thus produced was itself marginally intelligible. In the second scheme, the modulation was inverse. If the speech signal is regarded as a pattern of peaks rising above the time-frequency plane, the idea of the inverse modulation is to fill in the valleys and thus hide the pattern. This idea has merit. A given number of inversely modulated sinusoids impair speech intelligibility more than the same number of unmodulated sinusoids do. The advantage is only about 2.5 db for 16 sinusoids at a speech-to-interference ratio yielding 10 percent word articulation. It is a little greater than that at the level of 60 percent articulation, but that level is of little interest in connection with jamming. Reasons for not using the inverse-modulation techniques in jamming are mentioned. The most important is that, with the same amount of electronic equipment and the same jammer power more impairment of intelligibility can be produced with interference consisting of (about four times as many) unmodulated sinusoids.

Project & Task: 7681-76816 Contract No. AF18(600)-1219
ASTIA No. AD110090

(82)
AFCRC-TN-57-59 March 1958

Miller, George A.; Newman, Edwin B. (Harvard University)

TESTS OF A STATISTICAL EXPLANATION OF THE RANK-FREQUENCY RELATION FOR WORDS IN WRITTEN ENGLISH (Amer. J. Psychol., Vol. LXXI, 209-218, Mar 1958)

If the number of times each different word occurs in a sufficiently long passage of written English is counted, it will be found that a few words occur very frequently and the vast majority of words occur only a few times. It is well-known that there is a remarkable consistency to these frequencies, revealed in the following way: List the words in order of decreasing frequency and assign to each word a number corresponding to its rank in that order. (If several words have the same frequency, assign to them all their average rank.) Now plot the frequency of occurrence as a function of the rank-order. If the values are plotted on double-logarithmic coordinates, they will fall roughly along a straight line with a slope of approximately -1. If r is the rank order and f is the frequency of occurrence, then as a first approximation it seems to be true that $rf = C$, where C is a positive constant. This report analyzes the rank frequency relation of three texts. The task of tabulation was done on UNIVAC using two programs, one to count words by length and the second to construct word frequency tables. Results support earlier similar studies.

Project & Task: 7682-76825 Contract No. AF33(038)-14343
ASTIA No. AD110094

(83)
AFCRC-TN-57-62 December 1957

Shepard, Roger N. (Harvard University)

STIMULUS AND RESPONSE GENERALIZATION: DEDUCTION OF THE GENERALIZATION GRADIENT FROM A TRACE MODEL (Psychol. Rev., Vol. 65, No. 4, 242-256, 1958)

The problem of the relation between generalization and dissimilarity (i.e., the problem of the shape of the "gradient of generalization") is reexamined in the light of recent developments. With regard to experimental arrangements in which reinforcements are delivered in accordance with a one-to-one assignment of the responses to the stimuli (as in paired-associate learning), the following conclusions are drawn: (1) Measures of generalization can be defined in terms of the conditional probabilities with which the various stimuli lead to the various responses. (2) Thus defined, stimulus generalization and response generalization are both invariant functions of interstimulus and interresponse dissimilarities, respectively, provided that two conditions are met. First, dissimilarity is reinterpreted to mean a "psychological distance" which (a) is equivalent to "physical distance" except for a continuous, differentiable transformation, and (b) satisfies the metric axioms. Second, a given schedule of reinforcement is maintained. (3) Under conditions of frequent and regular reinforcement (as in the typical paired-associate experiment), the gradient of generalization is closely approximated by an exponential decay function (concave upward). (4) Under conditions of infrequent or intermittent reinforcement, this gradient departs from the exponential function in that it is convex upward in the vicinity of the reinforced stimulus or response. (5) The empirically observed gradients of generalization can be deduced from a mathematical model based upon four elementary assumptions concerning the temporal decay of stimulus and response traces.

Project & Task: 7682-76825 Contract No. AF33(038)-14343
ASTIA No. AD146753

(84)
AFCRC-TN-57-63 April 1958

Moser, Henry M.; Kirkconnell, Thomas W.; Wolfe, Susan M. (Ohio State University)

AN INTERIM REPORT ON INTERNATIONAL LANGUAGE FOR AVIATION

An earlier version of this material was prepared to defend the U. S. point of view that existing telegraphese procedures should be simplified, condensed, and incorporated into a minimum morphological and syntactical base. That version was circulated among members of the ICAO Radiotelephony Speech Panel and had some influence in the decision to recommend the phraseology approach over that of full sentences. The material in the present report, which incorporates suggestions made by the Speech Panel, has been revised to present a logical base for the standardization of present and future ILA. The aim has been to discover the fundamental principles used in radio-telephone communication, and to establish rules which will facilitate teaching and which can be followed to formulate phraseologies that have not been determined. In short, it proposes rules for an International Language for Aviation. It is hoped that this report will be studied carefully, and that constructive criticism will be made by those vitally concerned so that the final ILA will be acceptable to American pilots and ground-station operators. Table on Page 9 compares U. K. Complete Sentence R/T Procedures with ILA Telegraphese.

Project & Task: 7686-76861 Contract No. AF19(604)-1577
ASTIA No. AD146776

(85)
AFCRC-TN-57-64 December 1957

Tanner, Wilson P., Jr. (University of Michigan)

WHAT IS MASKING?

Three experiments are presented and analyzed in terms of a conventional definition of masking and a masking index conforming to this definition. It is demonstrated that, even though all of these experiments yield data permitting calculation of the masking index, that at least three distinct processes lead to this data: signal masking, distortion of the sound wave form, and listener distraction. Either masking theories should take these three processes into account, or masking should be redefined.

Project & Task: 7682-76822 Contract No. AF19(604)-2277
ASTIA No. AD146757

(86)
AFCRC-TN-58-2 March 1958

Spieth, Walter; Trittipoe, W. J. (Operational Applications Laboratory)

INTENSITY AND DURATION OF NOISE EXPOSURE AND TEMPORARY THRESHOLD SHIFTS (J. Acoust. Soc. Am., Vol. 30, No. 8, 710-713, Aug 1958)

What is the "trading relationship" between intensity and duration of exposures to loud sound in producing a given magnitude of temporary threshold shift (TTS)? Examination of the literature led to the hypothesis that duration is about twice as important as intensity: two exposures should produce the same TTS if one exposure were one-fourth the sound level (6 db less) and twice the duration of the other exposure. The hypothesis was tested on 12 human ears with thermal noise exposures ranging from 130 db SPL for 1 min to 94 db SPL for 64 min. In this series each doubling of duration was associated with a fourfold or 6 db decrease in sound level. TTS was measured at 2000, 4000, 6000, and 8000 cps. If the hypothesis were true, all exposures should have produced the same TTS. Actually the obtained average TTS, 5 min after exposure, described an inverted U-shaped function when plotted by increasing duration of exposure. The conditions from 118 db for 4 min through 100 db for 32 min produced roughly similar amounts of TTS, while the other conditions produced substantially less TTS. The shapes of the recovery curves differed systematically: At 4000 cps, the TTSs 20 sec after exposure were in perfect rank-order agreement with intensity of exposure, while from about 2 min to 10 min the inverted-U rank order was apparent.

Project: 7684
ASTIA No. AD146756

(87)
AFCRC-TN-58-5 July 1958

Doughty, Joseph M. (Operational Applications Laboratory)

SPEED AND ACCURACY OF PURSUIT-TRACKING USING THE JOYSPHERE CONTROL WITH DIFFERENT RATIOS OF CONTROL MOVEMENT TO TRACKING-PIP MOVEMENT

This is a report of an experiment to determine the optimal ratio of control movement in a joysphere control to the tracking-pip movement on a cathode-ray tube (CRT) in a pursuit-tracking task. For the magnitudes of tracking adjustments involved, there is very little difference in speed and accuracy between the ratios selected for study, although the data from both speed and accuracy measurements tend to favor a ratio of 1:1 in the control movement to tracking movement. Performance with the preferred hand shows a small but reliable superiority in speed and accuracy over that of the nonpreferred hand.

Project: 7687
ASTIA No. AD152568

(88)
AFCRC-TN-58-6 May 1958

Pollack, Irwin; Knaff, P. Robert (Operational Applications Laboratory)

MAINTENANCE OF ALERTNESS BY A LOUD AUDITORY SIGNAL (J. Acoust. Soc. Am., Vol. 30, No. 11, 1013-1016, Nov 1958)

An extremely serious operational problem is the maintenance of a high level of visual target detection performance during long periods of watch. Will a loud auditory signal aid in the maintenance of a high performance level under these conditions? Apparently, it will. When the failure to detect a target was coupled with the occurrence of the blast of a truck horn, average visual target detection percentages increased substantially, especially for the less proficient observers.

Project: 7682
ASTIA No. AD152569

(89)
AFCRC-TN-58-7 May 1958

Trittipoe, William J. (Operational Applications Laboratory)

RESIDUAL EFFECTS OF LOW NOISE LEVELS ON THE TEMPORARY THRESHOLD SHIFT (J. Acoust. Soc. Am., Vol. 30, No. 11, 1017-1019, Nov 1958)

The present study measures the temporary threshold shift (TTS) following two conditions of high-level noise exposure: (1) a control condition where the high-level noise is preceded by a period of silence; (2) an experimental condition where the high-level noise is preceded by noise levels which alone produce no apparent TTS. When the non-TTS-producing noise was coupled with the high-level noise, a greater threshold shift resulted than when equivalent periods of silence preceded the same high-level noise.

Project: 7684
ASTIA No. AD152645

(90)
AFCRC-TN-58-8 April 1958

Pollack, Irwin; Decker, Louis R.; Rubenstein, Herbert (Operational Applications Laboratory)

INTELLIGIBILITY OF SELECTED MESSAGE-SETS (J. Acoust. Soc. Am., Vol. 30, No. 7, 643, Jul 1958)

Four message-sets were constructed on the basis of phonemic confusion patterns with the aim of modifying the role of frequency-of-occurrence in the determination of speech intelligibility in noise. Deliberate selection of words may reinforce, nullify, or negate word-frequency effects for known message-sets.

Project: 7682
ASTIA No. AD152565

(91)
AFCRC-TN-58-9 July 1958

Pollack, Irwin (Operational Applications Laboratory)

BINAURAL COMMUNICATION SYSTEMS: PRELIMINARY EXAMINATION (J. Acoust. Soc. Am., Vol. 31, No. 1, 81-82, Jan 1959)

The principle of a communication system which purchases additional channels by shifting selective operations from equipments to human operators is examined. For selected conditions, the system may perform adequately for low-priority communications.

Project: 7681
ASTIA No. AD152652

(92)
AFCRC-TN-58-14 July 1958

Devoe, Donald B. (Operational Applications Laboratory)

SURVEY OF HUMAN FACTORS EFFORTS IN SAGE

Research on human factors problems in SAGE has been conducted by a number of nearly independent groups of human factors specialists. This report describes the missions of these groups, how they were established, what kinds of problems they have worked on, and what their future plans are. The reports generated by these groups are listed in a combined bibliography, and categorized reference lists bring together the reports relevant to various subject categories and SAGE functions.

Project & Task: 1975-76892
ASTIA No. AD160715

(93)
AFCRC-TN-58-15 August 1958

Pollack, Irwin; Johnson, Lawrence B. Jr. (Operational Applications Laboratory)

REPRODUCTION AND IDENTIFICATION OF ELEMENTS OF AUDITORY DISPLAYS (J. Acoust. Soc. Am., Vol. 31, No. 1, 7-8, Jan 1959)

The identification of the frequency of a tone was examined under four training procedures. The training procedures attempted to determine whether identification of tonal frequency could be improved by attaching distinctive motor responses to elements of the display. For relatively short training periods, such procedures were little more effective than simply providing verbal information of the correctness of the identification.

Project: 7682
ASTIA No. AD160708

(94)
AFCRC-TN-58-17 September 1958

Pollack, Irwin; Pickett, J. M. (Operational Applications Laboratory)

INTELLIGIBILITY AND PEAK-CLIPPED SPEECH AT HIGH NOISE LEVELS (J. Acoust. Soc. Am., Vol. 31, No. 1, 14-16, Jan 1959)

The effect of symmetrical speech peak clipping upon speech intelligibility in noise was examined. Over a wide range of conditions, intelligibility is independent of the level of peak clipping if the postclipping speech power is held constant. Peak clipping thus achieves protection of the ear against painfully loud speech without demanding a penalty of intelligibility. Indeed, under restricted ranges of conditions, peak clipping may actually improve intelligibility with a constant speech power.

Project: 7684
ASTIA No. AD160707

(95)
AFCRC-TN-58-50 February 1958

Miller, George A. (Harvard University)

FREE RECALL OF REDUNDANT STRINGS OF LETTERS (J. Exp. Psychol., Vol. 56, No. 6, 485-491, Dec 1958)

The present experiment explores the recall of redundant, as opposed to random, strings of symbols. First, an algebra for generating strings of symbols according to explicit rules is defined and a set of redundant strings is generated. A subset of these strings is memorized by S, using the method of free recall. As a control, the same procedure is used for equivalent strings generated by a table of random numbers. It is found that, although S knows nothing of the rules of formation, the redundant strings are more easily memorized. Since the redundant strings show greater intralist similarity, it is concluded that Ss group and recode the redundant strings, thus avoiding the interference effects that would be expected for the uncoded strings. In agreement with earlier studies, it is found that the amount of material learned increases when the strings are redundant, but the amount of information, measured in bits, decreases. In terms of the information measure, therefore, redundancy in the materials to be learned does not increase the efficiency of learning. The several parameters involved in these relations are briefly reviewed. The results also indicate that, for the particular redundancy used, some Ss find the redundant strings more difficult to learn if they have first learned a series of random strings.

Project & Task: 7682-76825 Contract No. AF33(038)-14343
ASTIA No. AD146780

(96)
AFCRC-TN-58-51 June 1958

Egan, James P. (Indiana University)

RECOGNITION MEMORY AND THE OPERATING CHARACTERISTIC

Forty-eight subjects were given 100 one syllable words to "learn" at three second intervals. Subjects were then given a simple task for four minutes. A list of 200 words was then given to the subjects for recognition including the 100 "learned" words mixed at random with 100 "new" words. Subjects were asked to rate each word in the 200 word list and to assign a score ranging from 1 to 7. The number one was assigned when subject was sure it was a learned word. The number seven was assigned when the subject was sure it was not a learned word. The purpose of the present experiment was to determine the form of the operating characteristic for recognition memory. The results must be regarded as preliminary in nature, because the specific form of the operating characteristic will depend upon a number of important parameters in the situation which were not systematically varied.

Project & Task: 7684-76841 Contract No. AF19(604)-1962
ASTIA No. AD152650

(97)
AFCRC-TN-58-53 April 1958

Bloch, Donald S. (Educational Research Corporation)

REVIEW OF QUALITATIVE PERSONNEL REQUIREMENTS FOR SAGE SYSTEM TECHNICAL COORDINATION CENTER

A SAGE Sector is extensive geographically and contains an enormous amount of complex and complicated equipment that is essential to the performance of the Air Defense Mission. This magnitude is of such an order that positions have been developed for personnel to provide communication and coordination among the maintenance agencies and groups for the various equipments, both in the Direction Center and at the various sites. These personnel will provide communication and coordination between the operations personnel and the maintenance personnel, and in addition will provide information on equipment status and technical advice to operations personnel. These personnel will work in the Technical Coordination Center on a shift basis with one Technical Coordination Officer and two Technical Coordination Technicians per shift. The TCC personnel will use printed materials, charts, and recording forms to perform their tasks, but practically their only item of equipment will be their telephone. There are differances of opinion concerning whether the TCO should be similar to a systems engineer and whether the TCO should have considerable training while the TCT should have little training. This report emphasizes that the TCO and TCT should have similar training. With certain job supports they can probably regionalize a system malfunction to the area of responsibility of a single maintenance agency chiefly by using common logic and coordinating and communicating skills rather than by using extensive electronics engineering knowledge and information on the detailed functioning of each item of SAGE equipment.

Project & Task: 1975-76892 Contract No. AF19(604)-2430
ASTIA No. AD152659

(98)
AFCRC-TN-58-54 April 1958

Moser, Henry M.; Oyer, Herbert J.; Wolfe, Susan M. (Ohio State University)

THE RELATIONSHIP OF PHONETIC STRUCTURE TO THE INTELLIGIBILITY OF WORDS SIMULTANEOUSLY RECORDED AT EAR AND LIPS

Previous study has shown that when speech signals were recorded at lips and left ears of speakers, and fed to headsets of trained listeners at specified S/N ratios, signals, origin ear, were significantly more intelligible than signals, origin lips. A comparative analysis is made of phonetic elements of listener response to speech signals, origins ear and lips, elicited in the earlier study. Listener responses totaled 72,000. Listeners highly trained on fifty words tend to restrict substitute responses to words within the list for signals of both origins. Fewer substitutions of words from outside the original list occur as noise in the listening condition becomes more destructive. Substitutions remain relatively constant between origins through ratios. Omissions for stimuli, origin lips, increase more rapidly. Number of sounds in the test stimuli had no differential effect on intelligibility when related to origin. The frequency of occurrence of two, three, four, and five sound word substitutes is in almost complete agreement with frequency of occurrence of two, three, four, and five sound words in the test list. Analysis of intelligibility errors relative to vowels and diphthongs in the test list revealed that words containing [æ, ʌ, ɑ, ɔ, ɑʊ, and ɔɪ] were less intelligible from origin ear, than origin lips through S/N ratios.

Project & Task: 7681-76813 Contract No. AF19(604)-1577
ASTIA No. AD152646

(99)
AFCRC-TN-58-57 September 1958

Moser, Henry M.; O'Neill, John J.; Oyer, Herbert J.; Wolfe, Susan M.; Schowe, Ben M. Jr. (Ohio State University)

A SURVEY OF FLIGHT-LINE HAND SIGNALS

This report is essentially a collection and preliminary survey of hand signals used by flight line personnel. Two Air Force publications were used as pictorial and descriptive sources and visits were made to an Air Force Base, a Naval station, and an aircraft factory. Photographs were taken of hand signals previously represented in publications by drawings. Modifications of these signs, new signs, and variations on the signs by a deaf man are also shown in photographs. Recommendations are made for further surveys and a pocket manual of photographed signs.

Project & Task: 7681-76813 Contract No. AF19(604)-1577
ASTIA No. AD160705

(100)
AFCRC-TN-58-58 September 1958

Upshaw, Harry S. (Educational Research Corporation)

DEVELOPMENT OF PROTOTYPE PROFICIENCY TESTS FOR SAGE OPERATORS: INTERCEPT DIRECTOR

This report describes the development of a Proficiency Test for SAGE Intercept Director, its rationale, the test results, and suggests modifications and further development. The planned test battery was designed to duplicate the job of Intercept Director as closely as possible in a test situation. The present pencil-and-paper instrument consists of fifty-six multiple-choice items, thirty-four are decision-making items and the remainder diagnostic items. The test was administered to forty-one examinees; nine from the Experimental SAGE Sector, seventeen from the New York Air Defense Sector, and fifteen instructors at the SAGE Technical Training Department of the 3380th Technical Training Group, Air Training Command. Four items were omitted at the New York Air Defense Sector because of differences in procedure. The statistical analysis is based on fifty-two items taken by all examinees. Any discussion of results must be regarded as tentative because of the small number of examinees. There is no appreciable difference in mean scores between the three groups. There are marked differences in variance which may be due to variations in length of experience and source of job knowledge. A limited item analysis indicates that the items seem to be satisfactory. The development of five additional tests is suggested. The total battery would consist of Part I: a revision of the present instrument, Part II: Scope-Reading Test, Part III: Ingenuity and Tactical Decisions Test, Part IV: Digital display reading speed test, Parts V and VI: tests of communication skill with pilot and technician.

Project & Task: 1975-76892 Contract No. AF41(657)-95

(101)
AFCRC-TN-58-59 August 1958

• Miller, George A.; Newman, Edwin B.; Friedman, Elizabeth A. (Harvard University)

LENGTH-FREQUENCY STATISTICS FOR WRITTEN ENGLISH (Information and Control, Vol. 1, No. 4, 370-389, Dec 1958)

The results of a tabulation of word frequencies in a sample of written English are analyzed in terms of word length and syntactic function. It is found that a simple stochastic model gives a rough prediction for the results obtained when all words are combined, but not when words are classified as function or content words. Function words are short and their frequency of occurrence is a decreasing function of their length; content words are longer and their probability is relatively independent of length.

Project & Task: 7682-76825 Contract No. AF33(038)-14343
ASTIA No. AD160709

(102)
AFCRC-TN-58-60 May 1959

Anderson, Clint D. (Indiana University)

THE CONSTANT-RATIO RULE AS A PREDICTOR OF CONFUSIONS AMONG VISUAL STIMULI OF BRIEF EXPOSURE DURATION

The constant-ratio rule states that, for a given stimulus, the ratios of response proportions are independent of the number of stimuli being discriminated. This rule provides a means of forming predictions of future performance following a change in the size of the stimulus set. Four highly practiced subjects were used to test the applicability of the rule with words presented under very brief visual exposure. The results, in conjunction with previous findings, support the contention that the constant-ratio rule holds independently of the sense modality used for discriminating.

Project & Task: 7684-76841 Contract No. AF19(604)-1962
ASTIA No. AD160706

(103)
AFCRC-TN-58-62 September 1958

Bredon, Ruth W. (Educational Research Corporation)

DEVELOPMENT OF PROTOTYPE PROFICIENCY TESTS FOR SAGE OPERATORS: IDENTIFICATION OFFICER AND IDENTIFICATION TECHNICIAN

This report describes the development of a SAGE Identification Officer Proficiency Test and a SAGE Identification Technician Proficiency Test. The rationale of their construction, the results of preliminary testing, and suggestions for revision are discussed. These tests are two of a series of tests for SAGE operators developed under Contract AF41(657)-95. The tests require examinees to make decisions like those required on the job. There are four parts to each of the tests. Parts I-III are in pencil-and-paper form, and are bound together in one booklet. Part I contains decision-making items and Parts II and III contain diagnostic items. Part IV is a performance test of proficiency in executing switch-actions. Generalizations from the test results must be regarded as being very tentative since they are based on a small number of examinees. Twenty-four examinees took the Identification Officer Proficiency Test and ten examinees took the Identification Technician Proficiency Test. The examinees were drawn from the Experimental SAGE Sector (ESS), the New York Air Defense Sector (NYADS), and the SAGE Technical Training Department (SAGE TTD) of the 3380th Technical Training Group, Air Training Command. The statistics in this report are based on items taken by all examinees for each test. The mean scores for the Identification Officer Proficiency Test show that the officers did better than the airmen; and that students did not do as well as the examinees at the Experimental SAGE Sector, the New York Air Defense Sector, or the instructors from the SAGE TTD. A limited item analysis for both tests indicated satisfactory item results.

Project & Task: 1975-76892 Contract No. AF41(657)-95

(104)
AFCRC-TN-58-63 September 1958

Kugris, Violette A. (Educational Research Corporation)

DEVELOPMENT OF PROTOTYPE PROFICIENCY TESTS FOR SAGE OPERATORS: TRACK INITIATOR

A proficiency test was constructed for the position of Track Initiator, for use at the Experimental SAGE Sector. The test was developed to provide estimates of operator's ability to solve typical problem situations by applying specific knowledges and procedures. The test items, to a large extent, were designed to require the examinee to make decisions similar to those he is required to make on the job. Additional items were constructed to measure areas of job knowledge that an examinee must know in order to solve the decision-making type items. The trial edition of the test was administered to sixty-eight individuals. A limited item analysis indicates that the items seem to be satisfactory. The results further indicate that the test has potential value for use in identifying proficient operators.

Project & Task: 1975-76892 Contract No. AF41(657)-95

(105)
AFCRC-TN-58-64 August 1958

Kugris, Violette A. (Educational Research Corporation)

DEVELOPMENT OF PROTOTYPE PROFICIENCY TESTS FOR SAGE OPERATORS: TRACK MONITOR

A proficiency test was constructed for the position of Track Monitor for use at the Experimental SAGE Sector. The items in the test are spread out over most of the range of difficulty; some items are very difficult, others are relatively easy while most of the items are of moderate difficulty. The test was administered to eighty individuals. A limited item analysis indicates that the items seem to be satisfactory. The results further indicate that the test has potential value for use in identifying proficient operators.

Project & Task: 1975-76892 Contract No. AF41(657)-95

(106)
AFCRC-TN-58-65 August 1958

Kugris, Violette A. (Educational Research Corporation)

DEVELOPMENT OF PROTOTYPE PROFICIENCY TESTS FOR SAGE OPERATORS: INITIATION SUPERVISOR

A proficiency test was constructed for the position of Initiation Supervisor, for use at the Experimental SAGE Sector. The test was administered to fifty-seven individuals. The results indicate the student group tends to be differentiated from other groups most clearly on the decision-making type items. In general, all examinees tend to have difficulty with items concerning information available to the operator, display features that provide this information and the interpretation and optimum use of available information. No definite conclusions can be drawn from the limited data. The results do indicate the test has potential value for use in providing measures of operator proficiency. It is recommended that a more detailed option analysis for each item be performed and the test refined.

Project & Task: 1975-76892 Contract No. AF41(657)-95

(107)
AFCRC-TN-58-66 September 1958

Brooks, W. Douglas (Educational Research Corporation)

DEVELOPMENT OF PROTOTYPE PROFICIENCY TESTS FOR SAGE OPERATORS: MANUAL DATA INPUTS PERSONNEL

This report describes the jobs of SAGE Manual Data Inputs personnel and the development of a test to measure the proficiency of these operators. The test was administered to personnel from the Experimental SAGE Sector, the New York Air Defense Sector, and to instructors and students of the SAGE Technical Training Department of the 3380th Technical Training Group, Air Training Command. Test results are analyzed with respect to internal consistency, validity and reliability. Results of the analysis indicate that the test is successful in discriminating between supervisors and technicians and among personnel of varying degrees of experience. Other evidence which is suggestive of test validity is presented and additional methods for further validation are proposed. Areas for possible improvement of the test are discussed.

Project & Task: 1975-76892 Contract No. AF41(657)-95

(108)
AFCRC-TN-58-70 September 1958

Parker, James F. Jr.; Price, Harold E.; Walker, Peyton G. (Psychological Research Associates)

METHODOLOGY USED IN THE DEVELOPMENT OF QUALITATIVE PERSONNEL REQUIREMENTS INFORMATION FOR THE TACTICAL AIR CONTROL SYSTEM (SYSTEM 314L)

The procedures used in developing qualitative personnel requirements information (QPRI) for the operator and maintenance positions of the AN/TSQ-13 Data Processing Subsystem for the Tactical Air Control System 314L are described in this report. End products derived from these procedures included: (1) Position definitions and resemblances of new positions to comparable positions in existing similar systems. (2) Preliminary manning estimates. (3) Training requirements for each new position. (4) Operator performance analysis diagrams. A method was derived which allowed a systematic assembling of information concerning this system and the use of this information in specifying system personnel requirements. Many assumptions were required at stages within the methodology. The methodology was structured in such a manner that, as information becomes available concerning the validity of these assumptions, the specified personnel system may be altered and refined.

Project & Task: 7687-76876 Contract No. AF41(657)-176

(109)
AFCRC-TN-58-72 November 1958

Swets, John A.; Shipley, Elizabeth F.; McKey, Molly J.; Green, David M. (Massachusetts Institute of Technology)

MULTIPLE OBSERVATIONS OF SIGNALS IN NOISE (J. Acoust. Soc. Am., Vol. 31, No. 4, 514-521, Apr 1959)

Tbe use of repeated presentations of a given signal event as an experimental technique in psychoacoustic studies provides information about several general properties of the hearing process. From the relationship between the gain in detectability that results from additional observations and the type of signal and noise employed, inferences can be made about: (1) the observer's ability to integrate over time, (2) the amount of noise generated by the auóitory system, (3) the nature of the process of frequency analysis, and (4) the observer's mode of dealing with uncertainty as to signal frequency. The first set of experiments permitted five observations of each signal where the signal consisted of a pulsed tone, of known frequency, in noise. Both variable noise, i. e., noise that is statistically independent from one presentation to another, and constant noise, i. e., noise that is exactly the same on each of the five presentations, were used. With variable noise, the detectability index d' improves, as predicted, as the square root of the number of the observations. The use of constant noise, which results in less improvement, provides an estimate of the portion of the total noise affecting detection that is of internal origin. The results under different levels of external noise indicate that internal noise is proportional to external noise. A second set of experiments employed signals whose frequencies were unknown to the observers, and signals comprised of several widely spaced frequencies. Their results are discussed in relation to three alternative models of tbe process of frequency analysis.

Project & Task: 7682-76822 Contract No. AF19(604)-1728
ASTIA No. AD248088

(110)
AFCRC-TN-58-73 May 1958

Swets, John A. (Massachusetts Institute of Technology)

ON SEQUENTIAL DECISIONS BY HUMAN OBSERVERS IN A SIGNAL DETECTION PROBLEM

In a sequential test of statistical hypotheses, a sample is taken, and one of three decisions is made: accept H_o, accept H_1, or take another sample. Samples are taken successively until the resulting sequence of samples is sufficiently persuading in favor of one or the other terminal decision. The criteria which are to be met before making a terminal decision are stated in terms of the error probabilities that lead to maximizing the expected value of a decision. These error probabilities, and hence the average number of samples preceding a terminal decision, are functions of the a priori probabilities of H_o and H_1, the values associated with the four possible outcomes of a terminal decision, the cost of taking a sample, and the divergence between the distributions of sample values expected under H_o and under H_1. The optimum sequential test generally requires less time on the average than a test of fixed length that yields the same error probabilities. This paper deals with an experimental application of the theory of sequential testing to the human observer making decisions concerning the presence of signals in noise. Our observers made as many observations as they chose before asserting the existence of noise alone or of signal plus noise. They knew, in each of several experiments which varied in these respects, the values of the situational parameters that ideally govern the choice of the decision criteria. Their performance is compared to optimum performance in terms of error probabilities and average number of observations. A comparison is also made of their relative efficiency in sequential tests and tests of fixed length.

Project & Task: 7682-76822 Contract No. AF19(604)-1728

(111)
AFCRC-TN-58-74 December 1958

Swets, John A. (Massachusetts Institute of Technology)

INDICES OF SIGNAL DETECTABILITY OBTAINED WITH VARIOUS PSYCHOPHYSICAL PROCEDURES
(J. Acoust. Soc. Am., Vol. 31, No. 4, 511-513, Apr 1959)

The index of detectability d' was estimated from data collected with various psychophysical procedures, specifically, the forced-choice method with different numbers of alternatives, and the yes-no method. The estimates were, in all instances, quite comparable. This result is comforting in view of the fact that none of the other indices extant provide a unification of data collected with different procedures. This result is also somewhat surprising in view of the fact that the calculation of d' assumes perfect memory, and forced-choice experiments were conducted with as many as eight temporal alternatives.

Project: 7682 Contract No. AF19(604)-1728
ASTIA No. AD248087

(112)
AFCRC-TN-59-7 March 1959

Pollack, Irwin (Operational Applications Laboratory)

IDENTIFICATION OF ELEMENTARY AUDITORY DISPLAYS AND THE METHOD OF RECOGNITION MEMORY (J. Acoust. Soc. Am., Vol. 31, No. 8, 1126-1128, Aug 1959)

The "method of recognition memory" is considered as a procedure which permits the examination of the identification of elementary auditory displays without requiring the assignment of arbitrary designations to the displays. The procedure is described and illustrative results are presented.

Project & Task: 7682-76821
ASTIA No. AD212076

(113)
AFCRC-TN-59-9 December 1959

Pollack, Irwin; Decker, Louis R.; Rubenstein, Herbert (Operational Applications Laboratory)

ANALYSIS OF INCORRECT RESPONSES TO AN UNKNOWN MESSAGE SET (J. Acoust. Soc. Am., Vol. 32, No. 4, 454-457, Apr 1960)

The incorrect responses of listeners to an unknown message set of 144 words, presented in noise, were analyzed. Attention was focused upon the word-frequency distribution of the incorrect responses and upon the proportion of the incorrect responses that were nonsense responses. Both measures were affected by the speech-to-noise ratio, but were approximately independent of the stimulus-word frequency.

Project & Task: 7682-76821
ASTIA No. AD216177

(114)
AFCRC-TN-59-10 1960

Pickett, J. M.; Rubenstein, Herbert (Operational Applications Laboratory)

PERCEPTION OF CONSONANT VOICING IN NOISE (Language and Speech, Vol. 3, Part 3, 155-163, Jul-Sep 1960)

Measurements are reported of the perception in noise of the occurrence of voicing in the English consonants /p, b, t, d, f, v, s, z/. The listeners' task was to report whether the consonant spoken was of the class /b, d, v, z/ (voiced) or of the class /p, t, f, s/ (unvoiced). The factors investigated were (1) the position of the consonant in the test utterance: initial, intervocalic or final; (2) the place of articulation: alveolar /t, d, s, z/, or labial, /p, f, b, v/; (3) the degree of occlusion: stop, /p, b, t, d/, or fricative, /f, v, s, z/, and (4) the spectrum of the masking noise: white noise or low-frequency noise. The absence of voicing was perceived better in alveolar consonants than in labials in low-frequency noise. Otherwise there were no large effects of position, place of articulation, or degree of occlusion, on voicing perception. The results are interpreted in terms of low-frequency cues to voicing which are independent of place of articulation and high-frequency cues which vary with place of articulation.

Project & Task: 7684-76841
ASTIA No. AD216767

(115)
AFCRC-TN-59-11 June 1959

Decker, Louis R.; Pollack, Irwin (Operational Applications Laboratory)

MULTIPLE OBSERVERS, MESSAGE RECEPTION, AND RATING SCALES (J. Acoust. Soc. Am., Vol. 31, No. 10, 1327-1328, Oct 1959)

The improvement of message reception in noise with multiple observers was analyzed. Two sets of decision rules were employed to select among the responses of three observers as follows: one based upon the response agreement among observers; one based upon the listeners' confidence ratings of accuracy of message reception. Confidence ratings substantially improved the selection of the correct message reception in the absence of response agreement among observers.

Project & Task: 7682-76822

(116)
AFCRC-TN-59-13 July 1959

Pickett, J. M.; Decker, Louis R. (Operational Applications Laboratory)

TIME FACTORS IN PERCEPTION OF A DOUBLE CONSONANT (Language and Speech, Vol. 3, Part 1, 11-17, Jan-Mar 1960)

A listening experiment was carried out to examine the perceptual distinction between a single stop consonant, /p/, and its double counterpart, /p-p/. The joint effects of two time factors are studied: (1) the duration of /p/-closure (silence) and (2) the rate of utterance of the surrounding test sentence. The test sentence, "He was the topic of the year", was recorded on tape and then, in a number of recorded copies, the duration of the /p/-closure was altered by inserting or removing tape. A group of listeners judged each of the altered sentences to be either "He was the topic of the year" or "He was the top pick of the year". Effects of ten closure duration (60, 100, 150, 200, 250, 300, 350, 400, 500, and 585 msec.) are studied in various combinations with five rates of utterance (2, 3, 4, 6, and 8 syllables per second). A threshold closure duration is defined to be the duration at which 60% of the judgments were topic. As the rate increased from 2 to 8 syllables per second, the threshold closure duration decreased from 320 to 140 msec. and at a progressively declining rate. This function of threshold closure duration vs. rate of utterance is found to be approximately parallel to the relation, for the unaltered sentences, between actual closure duration and rate of utterance.

Project & Task: 7684-76841
ASTIA No. AD238461

(117)
AFCRC-TN-59-14 1959

Rubenstein, Herbert; Decker, Louis R.; Pollack, Irwin (Operational Applications Laboratory)

WORD LENGTH AND INTELLIGIBILITY (Language and Speech, Vol. 2, Part 4, 175-178, Oct-Dec 1959)

Intelligibility tests were conducted with monosyllabic, bisyllabic and trisyllabic words under conditions of known and unknown message sets. Longer words were found to be more intelligible than shorter words in both known and unknown message sets. Differences in intelligibility among the different lengths are interpreted in terms of acoustic discriminability and relative word frequency.

Project & Task: 7682-76821
ASTIA No. AD273525

(118)
AFCRC-TN-59-15 August 1959

Pollack, Irwin; Trittipoe, William (Operational Applications Laboratory)

INTERAURAL NOISE CORRELATIONS: EXAMINATION OF VARIABLES (J. Acoust. Soc. Am., Vol. 31, No. 12, 1616-1618, Dec 1959)

The identification of interaural noise correlations was examined as a function of the: duration, sound level, frequency range, and interaural balance of the noise. Progressive changes in identification performance were observed with changes in the individual variables.

Project & Task: 7682-76823

(119)
AFCRC-TN-59-16 November 1959

Sumby, William H. (Operational Applications Laboratory)

THE CONTROL TOWER LANGUAGE: A CASE STUDY OF A SPECIALIZED LANGUAGE-IN-ACTION (Language and Speech, Vol. 3, Part 2, 61-70, Apr-Jun 1960)

A methodology is presented by which the constraint imposed upon a sublanguage by linguistic and non-linguistic factors is estimated. The asymptotic redundancy associated with the control tower language, when the materials analyzed were predicted letter sequences, was estimated to be 75 percent compared to 55 percent for newspaper text. The average constraint imposed upon the selection of message units by the physical situation was estimated to be approximately 82 percent. When the interaction of situational and linguistic constraints is considered, the estimated redundancy for the language-in-action is increased to 95 percent.

Project & Task: 7682-76821
ASTIA No. AD243917

(120)
AFCRC-TN-59-17 November 1959

Pollack, Irwin; Decker, Louis R. (Operational Applications Laboratory)

CONSONANT CONFUSIONS AND THE CONSTANT RATIO RULE (Language and Speech, Vol. 3, Part I, 1-6, Jan-Mar 1960)

The constant-ratio rule of Clarke was evaluated with spoken initial English consonants heard against noise: /f, h, l, r, w, y/, the cluster /hw/ and the absence of the initial consonant /#/. The average deviation between observed consonant confusions for three sets of 4 x 4 matrices and confusions predicted on the basis of the constant-ratio rule from the 8 x 8 matrix averaged about four percent over a wide range of S/N ratios. A tentative representational structure for the selected consonants, based on the confusion analysis, is presented.

Project: 7682
ASTIA No. AD238460

(121)
AFCRC-TN-59-50 February 1959

Egan, James P.; Schulman, Arthur I.; Greenberg, Gordon Z. (Indiana University)

OPERATING CHARACTERISTICS DETERMINED BY BINARY DECISIONS AND BY RATINGS (J. Acoust. Soc. Am., Vol. 31, No. 6, 768-773, Jun 1959)

With the theory of signal detectability as a frameword, two psychophysical experiments were conducted in which each observation interval was well defined for the listener. Each interval contained noise, and it either did or did not ($p=0.5$) contain a signal (1000 cps, 0.5 sec in duration). In separate sessions of the first experiment, either the listener gave a yes-no decision or he responded with a rating (1-4) after each observation interval. Operating characteristics were obtained with E/N_0 equal to 15.8. It is clear from the data that the trained listener can perform as well when he adopts the multiple criteria necessary for the rating method as when he adopts the single criterion required by the binary-decision procedure. In the second experiment, only the rating method was used to determine the relation between d' and E/N_0. The resulting function, for $d'<3.0$, approximates a straight line which passes through the origin and which has nearly the same slope as that obtained in other laboratories.

Project & Task: 7682-76822 Contract No. AF19(604)-1962
ASTIA No. AD216178

(122)
AFCRC-TN-59-52 September 1959

Dawson, Herbert E. (System Development Corporation)

THE VALIDITY OF WEATHER FORECASTS IN SAGE DISPLAYS

Samples of terminal weather data and forecasts covering two months for five airbases were analyzed to determine the validity of short-term forecasts of terminal conditions (ceiling and visibility). This work is part of an investigation aimed toward automating return-to-base procedures in SAGE. Two analyses of validity were made. Both show a dependence on weather trend. If the question asked is, "In classes of weather how often are forecasts correct?", the finding is that in stable weather forecasts are very frequently correct. In changing weather they are very infrequently correct. If the question is, "In classes of forecasts how often are they correct?", the finding is that only forecasts of continued good weather are frequently correct. Forecasts of continued marginal or continued poor weather are correct fairly often and forecasts of changing weather are correct infrequently. The results are explained in terms of excess forecasts of persistence and a tendency to forecast change more often in good than in poor weather. It is concluded that forecasts should not now be incorporated into automated return-to-base procedures.

Project & Task: 1975-76892 Contract No. AF19(604)-2635

(123)
AFCRC-TN-59-54 July 1959

Moser, Henry M. (Ohio State University)

THE EVOLUTION AND RATIONALE OF THE ICAO WORD-SPELLING ALPHABET

The development of the word-spelling alphabet is traced, and research methods and findings which led to the recommendation of the International Civil Aviation Organization (ICAO) alphabet as an optimum list for international communications are summarized. Questions regarding the desirability and efficiency of the new alphabet are discussed, with the view to presenting what the alphabet intends to accomplish. Some 200 word alphabets of the world are appended.

Project & Task: 7686-76861 Contract No. AF19(604)-4575
ASTIA No. AD227639

(124)
AFCRC-TN-59-56 September 1959

Moser, Henry M.; Oyer, Herbert J.; Fotheringham, Wallace C.; O'Neill, John J.; Wolfe, Susan M. (Ohio State University)

THE EFFECT OF AUDITORY STIMULATION ON THE PRONOUNCIATION OF ENGLISH WORDS BY NON-NATIVE SPEAKERS

Pronounciation of English words by foreign nationals before and after auditory stimulation was rated by experienced judges and tested for intelligibility with panels of naive American listeners. In general, auditory stimulation substantially improved pronounciation and intelligibility; it therefore appears to warrant further study as a means for improving communication among many-language groups.

Project & Task: 7686-76861, 76862, 76863 Contract No. AF19(604)-4575
ASTIA No. AD233256

(125)
AFCRC-TN-59-57 September 1959

Buchanan, G.; Clark, M.; Schafer, A. (System Development Corporation)

A DESCRIPTION OF THE STAR (STATISTICAL TREATMENT OF AIRCRAFT RETURNS) TRACKING AND TROUBLE DETECTION LOGIC

This Field Note describes the current form of the STAR (Statistical Treatment of Aircraft Returns) tracking and trouble detection logic. The STAR tracking logic has been developed for the SAGE system and introduces the following new concepts to SAGE tracking: (1) STAR prefers to use all the radar returns in a 5-1/2 or 6 mile search area (depending on previous tracking conditions) for estimating the position of an aircraft. The aircraft's position is estimated by calculating the average position (mean) of these returns. (2) STAR measures the dispersion (by computing the variance) of the returns around the average position and uses this measure as one indication of the dependability of the mean position. (3) STAR measures the discrepancy between the predicted position and the mean position. It uses this measure to detect a maneuver, and in conjunction with the variance measure, to indicate the dependability of the mean position. (4) Tracks are smoothed only once a frame. (5) A special method for associating data with tracks is used when tracks are within 12 miles of one another. (6) Untracked aircraft are detected and tracked during the time that the radar returns from the untracked aircraft might be associated with a tracked aircraft. In addition, the program includes a trouble detection technique that provides dependable cues about the effectiveness of automatic tracking. A detailed verbal description of the logic is presented, supplemented by flow diagrams. (See also AFCRC-TN-59-57 Correction No. 1 dated November 1959).

Project & Task: 1975-76892 Contract No. AF19(604)-2635
ASTIA No. AD230030

(126)
AFCRC-TN-59-60 September 1959

Creelman, C. Douglas (University of Michigan)

DETECTION OF SIGNALS OF UNCERTAIN FREQUENCY

Alternative models for extension of frequency sensitivity in human observers are discussed. One decision procedure for a multiple filter model is considered in some detail as a general model for decision situations in which each available response specifies a subset of the signal alternatives. Two experiments were conducted in an attempt to choose between a sweeping-filter model and a multiple-filter model. Detection in a two-alternative forced-choice experiment in which the signal could be one of two possible signals was measured as a test of the two models. The data, in connection with other available studies, are taken to show the need for a more complex model for auditory discrimination.

Project & Task: 7682-76822 Contract No. AF19(604)-2277
ASTIA No. AD241287

(127)
AFCRC-TN-59-62 November 1959

Soukup, Robert; Williamson, E. (System Development Corporation)

SPECIAL EXPERIMENTAL DISPLAY GENERATION PROGRAM (SEDGE): DESCRIPTION AND USER'S MANUAL

SEDGE is an XD-1 (or Q-7) program that processes a deck of input cards and then operates in real-time to generate a changing sequence of situation and digital displays. SEDGE was written to provide the SAGE Operator Analysis Project (SOAP) with an experimental tool to study and evaluate the interaction between displays and human operators.

Project & Task: 1975-76892 Contract No. AF19(604)-2635
ASTIA No. AD230034

(128)
AFCRC-TN-59-63 November 1959

Soukup, Robert (System Development Corporation)

INFORMATION SORT AND PREDICT

ISAP is a proposed program being written for use on the XD-1 or Q-7 Computers to provide SOAP (SAGE Operator Analysis Project) with a tool for evaluating certain types of statistical data. This document describes the proposal for such a program and the work completed.

Project & Task: 1975-76892 Contract No. AF19(604)-2635
ASTIA No. AD230035

(129)
AFCRC-TN-59-68 November 1959

Pistor, H. H.; Buchanan, D. A. (System Development Corporation)

DESCRIPTION OF SIMULATED SAGE OPERATOR POSITION

The apparatus was designed for use in testing arrangements and types of controls for insertion of instructions from SAGE consoles. It was constructed of salvaged parts from a SAGE console. The circuitry times, stores, and displays operator inputs. Stimulus material is optically projected onto a ground glass surface on the console.

Project & Task: 1975-76892 Contract No. AF19(604)-2635
ASTIA No. AD233921

(130)
AFCRC-TN-59-69 November 1959

Buchanan, G.; Clark, M. (System Development Corporation)

A DESCRIPTION OF THE STAR (STATISTICAL TREATMENT OF AIRCRAFT RETURNS) AUTOMATIC DATA TRAIL DETECTION AND TRACK INITIATION LOGIC

This field note describes the STAR automatic data trail detection and track initiation logic developed as an input to the STAR tracking program. The program has three advantages over the present SAGE initiation program. The program can detect all data trails in a sector, while limiting the establishment of tracks to special classes of data trails. The program detects data trails by associating a mean position of radar returns in one frame with an independently determined mean position in an adjacent frame. As aircraft speeds increase, this procedure will allow a more efficient processing of radar data than the present SAGE procedure. The program can be used as an independent check on automatic tracking performance. These advantages and certain changes in the Air Surveillance room operations are discussed.

Project & Task: 1975-76892 Contract No. AF19(604)-2635
ASTIA No. AD230037

(131)
AFCRC-TN-59-70 November 1959

Wolin, B. R. (System Development Corporation)

METHODOLOGY NOTE: ON THE DESIGN AND REDESIGN OF SYSTEMS

This Field Note discusses some characteristics of complex, man-computer information processing systems and an approach to the design and improvement of such systems. The contents stem directly from experience of a group performing research and development on the SAGE Air Defense System and represent an attempt to abstract from this experience those rules which have evolved and proved useful in answering questions like: Does (or will) a system have problems? What are they? Where is the basic source of any problem? How does one go about solving these problems? One of the most interesting by-products from any effort is the development of techniques or methodologies which may have more generality than the direct products of the effort itself. The hope that rules used to improve the SAGE system will also be applicable to other efforts and other systems led to the writing of this paper. It is hoped that this paper will contribute to the technologies of system design and system improvement.

Project & Task: 1975-76892 Contract No. AF19(604)-2635
ASTIA No. AD230585

(132)
AFCRC-TN-59-72 November 1959

Buchanan, G.; Clark, M.; Schafer, A. (System Development Corporation)

A DETAILED FLOW DIAGRAM OF THE STAR TRACKING AND TROUBLE DETECTION PROGRAM FOR MODEL 3

See abstract of AFCRC-TN-59-57

Project & Task: 1975-76892 Contract No. AF19(604)-2635
ASTIA No. AD230038

(133)
AFCRC-TN-59-73 November 1959

Moser, Henry M.; Durham, Robert E. (Ohio State University)

AN EXAMINATION OF THE SPOKEN VOCABULARY USED IN AIR TRAFFIC CONTROL

Word counts were made of air traffic communications at three domestic and two international airports located in high-traffic areas in the United States. Consecutive segments of two-way radiotelephone messages were analyzed for type-token ratios. Pilots and controllers use a very limited basic vocabulary. Although there are similarities in the vocabularies employed in Tower, Ground Control, and Approach Control, there are characteristic differences. In general, there are more differences between the several control facilities of one airport than among the vocabularies of the same control facility at different airports.

Project & Task: 7686-76861 Contract No. AF19(604)-4575
ASTIA No. AD233255

(134)
AFCRC-TN-59-74 November 1959

Roeber, Fred, W. (System Development Corporation)

APPLICATIONS OF GEOREF-LATITUDE, LONGITUDE CONVERTER

The GEOREF-LATITUDE, LONGITUDE CONVERTER breadboard model is a device which permits conversion either from Latitude-Longitude to GEOREF (World Geographic Reference Syctem) or the opposite for the North Western Hemisphere. With modification, this unit can be constructed to perform the above conversions for any portion of the earth's surface.

Project & Task: 1975-76892 Contract No. AF19(604)-2635

(135)
AFCRC-TN-59-75 December 1959

Moser, Henry M.; Oyer, Herbert J.; Fotheringham, Wallace C. (Ohio State University)

ORTHOGRAPHIC REPRESENTATIONS OF THE ENGLISH PRONOUNCIATION AS AN AID IN TEACHING ILA

Specially devised orthographies in Chinese, Dutch, French, German, Italian, Japanese, Korean, Spanish, and Thai were constructed for a list of common English aviation words as an aid to their pronounciation by foreign nationals. Those prepared for German, Japanese, and Spanish were employed with native speakers of these three languages at the AF Language School, Lackland Air Force Base, Texas. It was found that for each of these three groups, the specially designed orthographies, with or without the additional aid of auditory stimulation, resulted in significantly more intelligible pronounciations than the reading of these aviation words from only a printed list. Additionally, each individual speaker in this study improved the intelligibility of his pronounciations when aided by the appropriate orthography. The comparative value of orthography alone vs. orthograph plus auditory stimulation varies considerably among language groups. The average improvement would make a distinguishable difference in the air traffic communication setting.

Project & Task: 7686-76861 Contract No. AF19(604)-4575
ASTIA No. AD241940

(136)
AFCRC-TN-59-76 February 1960

Warburton, George B. Jr.; Lawrence, Kenneth A.; Marks, Melvin R. (Psychological Research Associates)

SAGE TASK-EQUIPMENT ANALYSIS: INTERCEPT DIRECTOR-INTERCEPT DIRECTOR TECHNICIAN

This report describes the operation of the Intercept Director-Intercept Director Technician team in the Boston Air Defense Sector (BOADS) of the SAGE system. The analysis is concerned with delineating the interface between man and machine or, in other terms, describing the relationship between the equipment to be operated and the task of the operator. The present memorandum is one of a series which, ultimately, will cover almost all of the positions in a SAGE Direction Center, and some of the positions in a SAGE Combat Center.

Project & Task: 1975-76892 Contract No. AF19(604)-5616
ASTIA No. AD234570

(137)
AFCRC-TN-60-51 April 1960

Warburton, George B. Jr.; Lawrence, Kenneth A.; Marks, Melvin R. (Psychological Research Associates)

SAGE TASK-EQUIPMENT ANALYSIS: TRACKING SUPERVISOR-TRACK MONITOR-TRACK MONITOR SPECIAL

This report describes the operation of the Tracking Supervisor-Track Monitor-Track Monitor Special team in the Boston Air Defense Sector (BOADS) of the SAGE system.

Project & Task: 1975-76892 Contract No. AF19(604)-5616
ASTIA No. AD236611

(138)
AFCRC-TN-60-52 April 1960

Lawrence, Kenneth A.; Marks, Melvin R. (Psychological Research Associates)

SAGE TASK-EQUIPMENT ANALYSIS: INITIATION SUPERVISOR-TRACK INITIATOR

This report describes the operation of the Initiation Supervisor-Track Initiator team in the Boston Air Defense Sector (BOADS) of the SAGE system.

Project & Task: 1975-76892 Contract No. AF19(604)-5616
ASTIA No. AD236612

(139)
AFCRC-TN-60-53 April 1960

McLaughlin, John T.; Marks, Melvin R. (Psychological Research Associates)

SAGE TASK-EQUIPMENT ANALYSIS: AIR SURVEILLANCE OFFICER-AIR SURVEILLANCE TECHNICIAN

This report describes the operation of the Air Surveillance Officer-Air Surveillance Technician team in the Boston Air Defense Sector (BOADS) of the SAGE system.

Project & Task: 1975-76892 Contract No. AF19(604)-5616
ASTIA No. AD236613

(140)
AFCRC-TN-60-54 April 1960

Weinfeld, Frederick D.; McLaughlin, John T.; Marks, Melvin R. (Psychological Research Associates)

STUDIES ON HEIGHT-RANGE INDICATOR OPERATOR PERFORMANCE

This report describes various studies, tests, and experiments conducted during an investigation of the human factors involved in Height-Range Indicator Operator (HRIOp) performance. The investigation consisted of an attempt to determine the degree to which negative height replies could be attributed to operator performance as opposed to environmental conditions prevailing within the height-finding system. These studies culminated with an investigation of the degree to which HRIOp performance could be improved as a result of an experimentally induced increase in motivation. Specific recommendations with respect to improving HRIOp performance are presented.

Project & Task: 1975-76892 Contract No. AF19(604)-5616
ASTIA No. AD235142

(141)
AFCRC-TN-60-55 April 1960

Walker, Walter T. III; Marks, Melvin R. (Psychological Research Associates)

SURVEY OF BROAD-BAND BLUE LIGHTING IN THE BOSTON AIR DEFENSE SECTOR DIRECTION CENTER

Measurements were made of illumination on the shelf and CRT of consoles for various operator positions in the Weapons, Air Surveillance, and Identification rooms during different shifts (crews). Statistically reliable differences were found among crews, rooms, and operator positions. Average illumination levels ranged from 0.006 to 0.096 foot candles. The data indicated that illumination depended on the preferences of specific crews in specific rooms in specific operator positions. Inspection of the facility for controlling the illumination indicated that it was being varied by crew members.

Project & Task: 1975-76892 Contract No. AF19(604)-5616
ASTIA No. AD236614

(142)
AFCCDD-TN-60-2 May 1960

Lawrence, Kenneth A.; Warburton, George B.; Marks, Melvin R. (Psychological Research Associates)

SAGE TASK-EQUIPMENT ANALYSIS: TRACKING OFFICER-TRACKING TECHNICIAN

This report describes the operation of the Tracking Officer-Tracking Technician team in the Boston Air Defense Sector (BOADS) of the SAGE system.

Project & Task: 1975-76892 Contract No. AF19(604)-5616
ASTIA No. AD236615

(143)
AFCCDD-TN-60-3 May 1960

McLaughlin, J.; Marks, Melvin R. (Psychological Research Associates)

SAGE TASK-EQUIPMENT ANALYSIS: HEIGHT SUPERVISOR-HEIGHT TECHNICIAN

This report describes the operation of the Height Supervisor-Height Technician team in the Boston Air Defense Sector (BOADS) of the SAGE system.

Project & Task: 1975-76892 Contract No. AF19(604)-5616
ASTIA No. AD245630

(144)
AFCCDD-TN-60-4 May 1960

McLaughlin, J.; Marks, Melvin R. (Psychological Research Associates)

SAGE TASK-EQUIPMENT ANALYSIS: OVERLAP TECHNICIAN

This report describes the operation of the Overlap Technician in the Boston Air Defense Sector (BOADS) of the SAGE system.

Project & Task: 1975-76892 Contract No. AF19(604)-5616
ASTIA No. AD407573

(145)
AFCCDD-TN-60-5 May 1960

McLaughlin, J.; Marks, Melvin R. (Psychological Research Associates)

SACE TASK-EQUIPMENT ANALYSIS: MAPPINC SUPERVISOR, LONC RANCE RADAR-RADAR MAPPER, GAP FILLER RADAR

This report describes the operation of the Mapping Supervisor, Long Range Radar-Radar Mapper, Gap Filler Radar team in the Boston Air Defense Section (BOADS) of the SAGE system.

Project & Task: 1975-76892 Contract No. AF19(604)-5616
ASTIA No. AD407571

(146)
AFCCDD-TN-60-6 May 1960

Weinfeld, Frederick D.; Marks, Melvin R. (Psychological Research Associates)

SAGE TASK-EQUIPMENT ANALYSIS: MANUAL DATA SUPERVISOR-MANUAL DATA SUPERVISOR ASSISTANT-MANUAL DATA TECHNICIAN

This report describes the operation of the Manual Data Supervisor-Manual Data Supervisor Assistant-Manual Data Technician team in the Boston Air Defense Sector (BOADS) of the SAGE system.

Project & Task: 1975-76892 Contract No. AF19(604)-5616
ASTIA No. AD245630

(147)
AFCCDD-TN-60-7 May 1960

McLaughlin, John T.; Marks, Melvin R. (Psychological Research Associates)

SAGE TASK-EQUIPMENT ANALYSIS: AIR TACTICS OFFICER

This report describes the operation of the Air Tactics Officer in the Boston Air Defense Sector (BOADS) of the SAGE system.

Project & Task: 1975-76892 Contract No. AF19(604)-5616
ASTIA No. AD245631

(148)
AFCCDD-TN-60-8 June 1960

Lawrence, Kenneth A.; Marks, Melvin R. (Psychological Research Associates)

SAGE TASK-EQUIPMENT ANALYSIS: IDENTIFICATION OFFICER-IDENTIFICATION TECHNICIAN

This report describes the operation of the Identification Officer-Identification Technician team in the Boston Air Defense Sector (BOADS) of the SACE system.

Project & Task: 1975-76892 Contract No. AF19(604)-5616
ASTIA No. AD245632

(149)
AFCCDD-TN-60-9 June 1960

Lawrence, Kenneth A.; Marks, Melvin R. (Psychological Research Associates)

SAGE TASK-EQUIPMENT ANALYSIS: SENIOR DIRECTOR-SENIOR DIRECTOR TECHNICIAN

This report describes the operation of the Senior Director-Senior Director Technician team in the Boston Air Defense Sector (BOADS) of the SAGE system.

Project & Task: 1975-76892 Contract No. AF19(604)-5866
ASTIA No. AD245633

(150)
AFCCDD-TN-60-10 June 1960

Warburton, George B. Jr.; Lawrence, Kenneth A.; Marks, Melvin R. (Psychological Research Associates)

SAGE TASK-EQUIPMENT ANALYSIS: WEAPONS DIRECTOR-WEAPONS DIRECTOR TECHNICIAN

This report describes the operation of the Weapons Director-Weapons Director Technician team in the Boston Air Defense Sector (BOADS) of the SAGE system.

Project & Task: 1975-76892 Contract No. AF19(604)-5866
ASTIA No. AD245634

(151)
AFCCDD-TN-60-11 June 1960

McLaughlin, John T.; Marks, Melvin R. (Psychological Research Associates)

SAGE TASK-EQUIPMENT ANALYSIS: SENIOR AIR SURVEILLANCE OFFICER-SENIOR AIR SURVEILLANCE TECHNICIAN

This report describes the operation of the Senior Air Surveillance Officer-Senior Air Surveillance Technician team in the 26th Air Division of the SAGE system.

Project & Task: 1975-76892 Contract No. AF19(604)-5866
ASTIA No. AD245635

(152)
AFCCDD-TN-60-12 June 1960

Weinfeld, Frederick D.; Marks, Melvin R. (Psychological Research Associates)

SAGE TASK-EQUIPMENT ANALYSIS: SENIOR CONTROLLER-SENIOR CONTROLLER TECHNICIAN

This report describes the operation of the Senior Controller-Senior Controller Technician team in the 26th Air Division of the SAGE system.

Project & Task: 1975-76892 Contract No. AF19(604)-5866
ASTIA No. AD245636

(153)
AFCCDD-TN-60-13 May 1960

Tanner, Wilson P. Jr. (University of Michigan)

THE THEORY OF SIGNAL DETECTABILITY AS AN INTERPRETIVE TOOL FOR PSYCHOPHYSICAL DATA

The theory of signal detectability is examined from the standpoint of determining a set of satisfactory assumptions for the purpose of developing an interpretive tool for use in psychophysical experiments. It is concluded that the assumption, that the observer attempts to maximize the expected value of the outcome of the experiment, is satisfactory for this purpose, and that a set of physical conditions can be established which justify a computation of the detectability of a signal in noise based on a finite sampling plan involving 2 WT amplitude values over the open interval, 0 to T.

Project & Task: 7682-76822 Contract No. AF19(604)-2277
ASTIA No. AD239025

(154)
AFCCDD-TN-60-14 June 1960

Creelman, C. Douglas (University of Michigan)

APPLICATIONS OF SIGNAL DETECTABILITY THEORY TO PSYCHOPHYSICAL RESEARCH: A BIBLIOGRAPHY

The bibliography is an attempt to bring together references to current research and theoretical efforts, mathematical foundations, and work in related areas. The bibliography is divided into four main sections. The first lists books, handbook chapters, and chapters in symposia which are concerned with detectability theory, and which are enclosed in hard covers. This is followed by the most important section which lists papers which have appeared in technical journals.

Project & Task: 7682-76822 Contract No. AF19(604)-2277
ASTIA No. AD239026

(155)
AFCCDD-TN-60-15 May 1960

Green, Norman E. (Operational Applications Laboratory)

FATIGUE AND TENSION IN SAGE OPERATOR-TEAM PERFORMANCE: A SOCIOLOGICAL ANALYSIS

This study has undertaken a sociological approach to clarifying the problem of fatigue and tension in operator-team performance in command and control type systems. Focusing on the SAGE Direction Center work milieu, an analysis of survey-questionnaire responses leads to the following conclusions: (1) As expressed by the operator-teams themselves there is convincing evidence of both fatigue and tension in the work groups studied. (2) There are real differences between work groups in the extent of the fatigue and tension reactions expressed. (3) Fatigue and tension are significantly related to (a) group cohesiveness, (b) adjustment to operational pressure, (c) satisfaction with supervisory structure and (d) satisfaction with organizational information channels. Work groups which respond more favorably and more positively regarding these four sociological factors are characterized by less fatigue and tension. (4) While all six variables are significantly inter-related, the group cohesiveness factor is outstanding as the most efficient single "predictor" of all the others. (5) The differences between functional activities in work processes, job requirements and conditions explain a major portion of the variation in work group behavioral patterns.

Project & Task: 1975-76893
ASTIA No. AD239461

(156)
AFCCDD-TN-60-19 June 1960

Lawrence, Kenneth A.; Marks, Melvin R. (Psychological Research Associates)

DEVELOPMENT OF A DECISION-MAKING PAPER-AND-PENCIL TEST FOR THE SENIOR DIRECTOR POSITION IN SAGE

This report describes the development and tryout of a paper-and-pencil test for the Senior Director position in SAGE. The test represents a relatively new technique in that it requires the making of connected decisions in a simulated time sequence. The tryout indicates that the test is acceptable to Senior Director, and is believed by them to be an improvement over conventional multiple choice paper-and-pencil testing of informational material.

Project & Task: 1975-76892 Contract No. AF19(604)-5616
ASTIA No. AD407572

(157)
AFCCDD-TN-60-20 June 1960

Story, Anne W. (Operational Applications Laboratory)

THE EFFECT OF STIMULUS VARIABILITY ON PREDICTION OF MAGNITUDE

According to probability matching experiments, Ss' asymptotic probability of predicting an event equals the frequency with which that event has occurred. Such events have been invariant. An alternative, however, frequently varies over time. Apparently the more variable the alternative, the less will be its predicted magnitude.

Project & Task: 4690-46902
ASTIA No. AD239517

(158)
AFCCDD-TN-60-23 1960

Pollack, Irwin (Operational Applications Laboratory)

MESSAGE UNCERTAINTY AND MESSAGE RECEPTION II (Language and Speech, Vol. 3, Part III, 174-177, Jul-Sep 1960)

A previous experiment indicated (1) that the accuracy of message reception is relatively independent of the size of the message ensemble if the number of response alternatives is held constant; and (2) that the accuracy of monitoring performance is independent of the number of irrelevant response alternatives. The present study attempts to determine whether the same generalizations are warranted in the case where the message and response alternatives are randomly chosen from the English language. They are.

Project: 7682
ASTIA No. AD250739

(159)
AFCCDD-TN-60-24 1960

Pollack, Irwin; Rubenstein, Herbert; Horowitz, Arnold (Operational Applications Laboratory)

COMMUNICATION OF VERBAL MODES OF EXPRESSION (Language and Speech, Vol. 3, Part III, 121-130, Jul-Sep 1960)

Talkers were instructed to read neutral sentences and "sound happy", or "sound bored", etc. Listeners attempted to identify the intended mode of expression drawing their responses from a limited number of alternatives. Results are presented showing how the identification of modes of expression is affected by: (1) number of response alternatives, (2) noise, (3) whispering, and (4) temporal sampling. Reasonably high levels of performance may be achieved under conditions of reduced acoustic information.

Project: 7684
ASTIA No. AD250738

(160)
AFCCDD-TN-60-25 April 1960

Frankmann, Judith P.; Adams, Jack A. (University of Illinois)

THEORIES OF VIGILANCE

The increasing use of automation in complex military and industrial systems is steadily changing the role of the human operator to that of a monitor of visual and auditory displays for detecting events which require human response--either for routine augmentation of normal system functioning or to handle an atypical emergency whose solution is outside the programmed sequences of the semi-automatic or automatic equipment. The subject of this report is a review of contemporary theories of monitoring behavior which attempt to account for the empirical findings on variables influencing the attentiveness of the human operator under conditions of prolonged monitoring. The four principal theories reviewed are: inhibition, attention, expectancy, and sensory variation. The most serious problem at this time is a lack of theoretical specificity. The inhibition and attention hypotheses are the least useful of the four theories. Expectancy, as an organismic state determining the response level of operator, is being given increased research attention and refinement. The sensory variation hypothesis, which proposes a requirement of the central nervous system for variety of impinging stimuli, is the most successful of the four theoretical positions in accounting for our present-day findings. However, its success may partly be a function of its generality, with a consequent inability of the theory to produce precise doductions whose lack of empirical verification would constitute negative evidence for the theoretical view. The sensory variation hypothesis has received the least direct attention of all the theories of vigilance, but the potential scope of its explanatory power could be large. Increased formalization of this hypothesis could be fruitful, particularly in integrating the different behavioral trends found for simple and complex monitoring tasks.

Project & Task: 7684-76893 Contract No. AF19(604)-5705
ASTIA No. AD245063

(161)
AFCCDD-TN-60-26 1960

McLaughlin, John T.; Walker, Walter T. III; Carter, Robert F.; Weiss, Edward C.; Wulff, J. Jepson (Psychological Research Associates)

DESIGN AND EVALUATION OF A SELF-TUTORING METHOD FOR ON-SITE TRAINING IN SAGE AN/FST-2 TROUBLESHOOTING

The study reported was undertaken in partial fulfillment of a qualitative operational requirement submitted by Headquarters, ADC to Headquarters, USAF. The work was accomplished for the 416L Project Office. The study was conducted to provide materials and functional specifications for a self-instructional device. The training materials provided for fault localization within the Fine Grain Data Section of the AN/FST-2. Fault localization was to the smallest functional unit which could be determined through the use of built-in indicators. Prototype training materials and functional specifications for a versatile fully automated device are presented.

Project & Task: 1975-76892 Contract No. AF19(604)-5616
ASTIA No. AD245637

(162)
AFCCDD-TN-60-27 June 1960

Marks, Melvin R. (Psychological Research Associates)

THE DEVELOPMENT OF JOB PROFICIENCY TESTS FOR SELECTED OPERATOR POSITIONS IN THE WEAPONS BRANCH

The research reported herein was concerned with the development of paper-and-pencil job knowledge tests for six positions in the Weapons Branch of a Direction Center in the SAGE system. Actually, three tests were developed, the positions being paired as follows: Senior Director/Senior Director Technician (SD/SDT); Weapons Director/Weapons Director Technician (WD/WDT); Intercept Director/Intercept Director Technician (IND/INT). The report treats the job description techniques, rationale for test outline, item development, preliminary try-out in the New York Air Defense Sector (NYADS), item analysis and test revision, final administration at the Boston and Syracuse Air Defense Sectors (BOADS and SYADS), and at the training facility at Richards-Gebaur Air Force Base (RG). Also included are information on test reliability and validity, and recommendations for normative use of the tests. The test materials, including the items, and instructions for administering, scoring, and interpreting the results, are printed in a separate booklet.

Project & Task: 1975-76892 Contract No. AF19(604)-5616
ASTIA No. AD404599

(163)
AFCCDD-TN-60-32 July 1960

Doughty, Joseph M. (Operational Applications Laboratory)

A SIMULATION FACILITY FOR THE EXPERIMENTAL STUDY OF DECISION MAKING IN COMPLEX MILITARY SYSTEMS

A system simulation facility and methodology for the study of human decision-making in military air surveillance systems is described. Contemplated experimental studies of decision-making at various levels of command and in various functions is outlined. Results of preliminary development of procedures and measures of performance are given.

Project & Task: 4690-46902
ASTIA No. AD241153

(164)
AFCCDD-TN-60-39 September 1960

Moser, Henry M.; Oyer, Herbert J.; Fotheringham, Wallace C.; Henderhan, Robert C. (Ohio State University)

VOWEL DISCRIMINATION AMONG FOREIGN NATIONALS

This study is concerned with the ability of foreign nationals to discriminate between English vowels. A paired-comparison type of test utilizing same (S) or different (D) vowels and dipthongs was presented to several listening panels of American and foreign nationals. Results indicate (1) that the use of a vowel discrimination test is advisable in the case of foreign nationals and (2) that one way for a foreign national to attain proficiency in English vowel discrimination is through phonetic training.

Project & Task: 7684-76842 Contract No. AF19(604)-4575
ASTIA No. AD247144

(165)
AFCCDD-TN-60-40 December 1960

Moser, Henry M.; Fotheringham, Wallace C. (Ohio State University)

NUMBER TELLING

Intelligibility and confusability values of 16 variants of the English digits were studied in sufficient noise to produce about 50 percent error. Ten speakers representing five different native-language backgrounds spoke the English digit variants to approximately 250 American listeners. The study provided 21,540 responses to each digit; about half of these were responses to stimuli which had been filtered above 2800 cps. Results reveal a quite stable order of digit intelligibility which was: 5, 1, 7, 0, 6, 4, 9, 8, 2, and 3. Of the variants, THREE and FREE were equally intelligible and significantly better than TREE; OH, FOUR, FIVE, and NINE were significantly better than ZERO, FOWer, FIFE, and NINer, respectively. FIFE was somewhat superior to FIVE for speakers whose native-language was Spanish. The difference between filtered and unfiltered signals was statistically significant but hardly of practical importance. The digits (3) and (0) were the most frequent substitutions for other digits; (5) and (9) were the least frequently confused. At least one significant confusion exists for each of the digits. No digit avoids being a significant confusion for at least one other digit. Variants of the same digit tend to be associated with the same confusion.

Project & Task: 7686-76861 Contract No. AF19(604)-4575
ASTIA No. AD260457 Contract No. AF19(604)-6179

(166)
AFCCDD-TN-60-51 September 1960

Mayer, Sylvia R. (Operational Applications Laboratory)

USE OF A TEACHING MACHINE FOR AIR FORCE ON-THE-JOB TRAINING IN THE SAGE SYSTEM

A teaching machine was used for military on-the-job training in SAGE operations over a sixteen-month period. This was a follow-up of a brief feasibility study. The purpose was (1) to see if the initial enthusiasm for auto-instruction would continue and increase as the novelty effect waned, and (2) to uncover unanticipated implementation problems. Operators sustained and increased their use of the teaching machine during the observation period. The training staff continued to favor use of the device. Patterns of usage related to program familiarity and crew proficiency are described. Problems in application of auto-instruction are noted. Some may be unique to military on-the-job training for complex electronic systems such as SAGE. These problems relate to (1) programming capability, (2) types of training tasks, (3) teaching machine design, and (4) program design. Some research requirements are indicated.

Project & Task: 1975-76893
ASTIA No. AD250277

(167)
AFCCDD-TN-60-57 February 1961

Rubenstein, Herbert, Pollack, Irwin (Operational Applications Laboratory)

DESCENT OF THE MEDIAN: REPLY TO GERSTMAN AND BRICKER (J. Acoust. Soc. Am., Vol. 33, No. 5, 697-699, May 1961)

In the presentation of an unknown message set in noise, the median word frequency of the incorrect responses is shown to be inversely related to the speech-to-noise ratio. The hypothesis that this relationship is an epiphenomenon of increasing knowledge of the message set is rejected.

Project: 7682
ASTIA No. AD259886

(168)
AFCCDD-TN-60-58 November 1960

Moser, Henry M. (Ohio State University)

ONE-SYLLABLE WORDS—REVISED AND ARRANGED BY ENDING SOUNDS

This report presents a systematic listing of the monosyllabic words in American English according to their ending sounds. It represents a complete revision of ONE-SYLLABLE WORDS, AFCRC-TN-55-56, in that all words have been reexamined, errors have been corrected, a few words have been deleted, and a number of new words have been added. The summary charts have been revised, and charts of the beginning and ending sounds with the individual vowels and dipthongs have been added. Some changes have been made in the section on INCLUSIONS, EXCLUSIONS, and QUALIFICATIONS. For the most part, the two reports supplement each other; the earlier report presents an arrangement according to beginning consonant sounds, the latest report presents work according to ending sounds.

Project & Task: 7684-76844 Contract No. AF19(604)-4575
ASTIA No. AD248933

(169)
AFCCDD-TN-60-59 December 1960

Newman, Anthony K. (Ohio State University)

A LABORATORY STANDARD SIGNAL-TO-NOISE EQUALIZER

This report describes a laboratory standard instrument. This instrument is designed to measure and equate the peak voltage of a word, or the average peak voltage of a group of words, with the rms voltage of suitably filtered Gaussian noise in such a way as to produce a well-defined standard signal-to-noise ratio of zero db. Relative to this zero standard ratio, any practical signal-to-noise ratio may be obtained by adjusting either the noise or the speech channel attenuators. An increase in the attenuation of the noise or a decrease in the attenuation of the speech will have the effect of increasing the signal-to-noise ratio. The important features of this instrument are: (1) a panel meter provides a continuous measurement of the Gaussian noise so that during playback or re-recording of an experimental tape through the laboratory standard, the signal-to-noise ratio may be checked and maintained constant; (2) a five-channel instantaneous amplitude-discriminator measures and standardizes the auditory input to the laboratory standard whereby variations in speech-peaks may be checked, and corrected if desired; and, (3) both the noise meter and the amplitude-discriminator monitor the operation of the laboratory standard continuously to ensure that a constant signal-to-noise ratio is maintained.

Project & Task: 7686-76863 Contract No. AF19(604)-4575
ASTIA No. AD260458

(170)
AFCCDD-TN-60-60 December 1960

Devoe, Donald B.; Duva, James S. (Operational Applications Laboratory)

DISPLAY SHARING THROUGH COLOR FILTERING

A method of display sharing through the projection of several different displays onto the same screen and selecting the desired display by viewing through an appropriately colored filter is described, and several applications of the technique are discussed.

Project & Task: 9674-96745
ASTIA No. AD249788

(171)
AFCCDD-TN-60-61

Weiss, Edward C.; Wulff, J. Jepson (Psychological Research Associates)

DESIGN AND EVALUATION OF A SELF-TUTORING METHOD FOR ON-SITE TRAINING IN SAGE AN/FST-2 TROUBLESHOOTING, II A REVISED PROGRAM

A previous study, reported in AFCCDD-TN-60-26, developed and field tested a programmed course of instruction to foster maintenance performance by AN/FST-2 maintenance technicians. The present report describes a work effort which was initiated to translate the prototype training materials developed during the previous study into a storyboard format which a sound film could be produced. However, because the results of the field test indicated certain deficiencies in the previous program the storyboard materials are more than a translation of the previous text into a format which meets the requirements for the production of a film. Rather, they represent a complete revision of the prototype course in terms of the troubleshooting procedures and materials, the course program, and the more mechanical aspects of the training materials such as the test procedures which are employed. The most significant aspect of the revision is the elimination of the more generalized aspects of troubleshooting, per se, and a heavier emphasis from the outset on their application to the AN/FST-2. A diagram of the new program is also presented.

Project & Task: 1975-76892 Contract No. AF19(604)-5616
ASTIA No. AD249863

(172)
AFCCDD-TN-60-63 October 1960

Adams, Jack A.; Boulter, Lawrence R. (University of Illinois)

MONITORING OF COMPLEX VISUAL DISPLAYS: I. EFFECTS OF RESPONSE COMPLEXITY AND INTER-SIGNAL INTERVAL ON VIGILANT BEHAVIOR WHEN VISUAL LOAD IS MODERATE

The trend of modern semi-automatic man-machine systems is toward increasing emphasis on the human operator for monitoring and decision-making functions, with computers and automatic controls assuming many routine response functions. In recognition of this changing emphasis, a laboratory experiment was performed, within the context of a surveillance task patterned after that of SAGE, on the human operator's speed in detecting the occurrence of random signals over a continuous three-hour period of monitoring a display with six aircraft symbology units. Changes in behavior over the three hours were evaluated as a function of mean inter-signal interval and response complexity. Virtually all signal changes were detected. When response requirements were simple and the subject merely had to detect the occurrence of a change, some decrement over the three hours was observed for response speed, but when the response involved a four-choice decision no decrement was found. Evidence was presented for some of the decrement being associated with a deterioration of effective visual scanning of spatially disparate stimulus sources. Results were seen in support of a sensory variation hypothesis where variety in the external environment and in internal response-produced stimuli are factors in sustaining alertness, and thus responsiveness. The hypothesis is considered to be in a preliminary form.

Project & Task: 1975-76893 Contract No. AF19(604)-5705
ASTIA No. AD250789

(173)
AFCCDD-TN-61-1 February 1961

Egan, James P.; Schulman, Arthur I.; Greenberg, Gordon Z. (Indiana University)

MEMORY FOR WAVEFORM AND TIME UNCERTAINTY IN AUDITORY DETECTION (J. Acoust. Soc. Am., Vol. 33, No. 6, 779-781, Jun 1961)

An experiment was conducted to determine how well listeners could judge whether or not a signal was presented in a noisy observation interval which had already occurred. The cardinal feature of the experiment is that the observation interval is not marked off for the listeners until some fixed time after its occurrence. The listening situation is described as follows. With a probability of 0.5, the signal (1000 cps, 0.25 sec) is presented at a randomly selected instant. A fixed time thereafter, the listener is informed (by a flash of light) of the real time at which the sinusoid may have occurred, and he responds with a rating of confidence. As compared with the typical fixed-interval experiment in auditory detection, two sources of uncertainty are emphasized in this situation: (1) The listener has a faulty memory of his transformation of the input waveform, and (2) he has a faulty estimation of the time of onset of the signal. From the results of previous experiments on the role of time uncertainty in detection, it appears that a fair portion of the decrement in performance results from poor memory for the input waveform.

Project & Task: 7684-76841 Contract No. AF19(604)-1962

(174)
AFCCDD-TN-61-2 November 1960

Smith, Wellington E. (IBM Command Control Center)

RANDOM WALK MONITORING TECHNIQUE

In this report, the computer-programmed technique Random Walk Monitoring is discussed. This program was designed to be used as a tool for measuring an operator's monitoring performance for multiple-target monitoring. Some of the uses to which this program can be put are summarized, and the results of the validating procedure are given. Equations are derived for operator performance as a function of Need Rate and Number of Tracks.

Project & Task: 1975-76891 Contract No. AF30(635)-1404
ASTIA No. AD252036

(175)
AFCCDD-TN-61-3 November 1960

Halsey, Rita M. (IBM Command Control Center)

CHARACTER DESIGNS IN A 5X 7 MATRIX OF SQUARES

Factors affecting legibility of numerals composed of a 5 x 7 matrix of squares have been investigated. This experiment was conducted to: (1) determine legibility as a function of the brightness of the numerals and the size of individual elements comprising the numerals, and (2) to generate a confusion matrix for the numerals used, as an initial step toward designing a legible set of numerals. A suggested set of numeral designs (which has not been evaluated experimentally) has been devised.

Project & Task: 1975-76891 Contract No. AF30(635)-1404
ASTIA No. AD252030

(176)
AFCCDD-TN-61-4 November 1960

Wassertheil, Sylvia M. (IBM Command Control Center)

EVALUATION OF TWO TYPES OF MANUAL INPUT PUSHBUTTONS

This experiment was conducted to determine how various pushbutton designs would affect input speed and accuracy. Two pilot study pushbutton designs were chosen which should theoretically produce the greatest differences. There were no experimentally measurable differences.

Project & Task: 1975-76891 Contract No. AF30(635)-1404
ASTIA No. AD252033

(177)
AFCCDD-TN-61-5 November 1960

Pettie, Charles R. (IBM Command Control Center)

EFFECTS OF REQUIRING A TRACK NUMBER TO BE ASSOCIATED WITH A PARTICULAR DATA TRAIL

The Random Walk Monitoring program was modified to display an additional 3-digit track number to uniquely identify each vector. Corrective action could be rendered by a subject, only if the vector so identified was that assigned by the program to the trail in question. The effect of the additional discrimination and attendant manual input was compared with the results from the load study.

Project & Task: 1975-76891 Contract No. AF30(635)-1404
ASTIA No. AD252032

(178)
AFCCDD-TN-61-6 November 1960

Marill, Thomas M. (IBM Command Control Center)

COMBINATORIAL ASPECTS OF INFORMATION RETRIEVAL

An abstract information retrieval situation is investigated. There are certain items stored in memory; each item is described by a set of binary descriptors; the items are called out of memory according to a retrieval specification expressed in terms of the descriptors. A standard notation for retrieval specification is developed. It is shown how any given specification can be built up out of simple specifications. Results are given pertaining to the total number of specifications, and the number of possible simple specifications required to build up an arbitrary specification.

Project & Task: 1975-76891 Contract No. AF30(635)-1404
ASTIA No. AD252031

(179)
AFCCDD-TN-61-7 November 1960

Halsey, Rita M. (IBM Command Control Center)

FACTORS INFLUENCING THE LEGIBILITY OF SAGE DISPLAYS

Fifteen experiments were conducted with SAGE consoles on the effects of variables such as room illumination (color and amount), tube intensity, intensification time, character size, and display rate. Three procedures were used. One measured reading time for static alpha-numeric material; one measured reading accuracy for changing symbology; and one measured tracking performance. Many interactions were found among the principal variables. Tbe results are applicable to both SAGE-I and SAGE-II displays.

Project & Task: 1975-76891 Contract No. AF30(635)-1404
ASTIA No. AD252034

(180)
AFCCDD-TN-61-8 November 1960

Walker, L. C.; Wassertheil, Sylvia M. (IBM Command Control Center)

NEW TECHNIQUES FOR DISPLAYING RADAR DATA

For a display which selectively erases and stores, the continuity provided by tbe phosphor must be replaced by some sort of systematic patterning of the radar returns. Five patterns were investigated in this study. It was found that the presentation of only one unit at a time gave poor discriminability.

Project & Task: 1975-76891 Contract No. AF30(635)-1404
ASTIA No. AD252035

(181)
AFCCDD-TN-61-9 November 1960

Fredkin, E. (IBM Command Control Center)

TRIE MEMORY

The work reported here was (1) begun at the MIT Lincoln Laboratory and (2) completed at Bolt Beranek and Newman, Incorporated with contractual support from the IBM Federal Systems Division and computer support from the Lincoln Laboratory. The TRIE Memory project had as its objective the improvement of display design through the application of information-retrieval techniques.

Project & Task: 1975-76891 Contract No. AF30(635)-1404
ASTIA No. AD252037

(182)
AFCCDD-TN-61-13 November 1960

Walker, L. C. (International Business Machines Corporation)

TWO EXPERIMENTS ON THE EFFECTS OF CLUTTER DENSITY ON RADAR TRAIL DETECTION

The work described here represents continued investigation of the techniques for improving radar trail detection in clutter. (SECRET supplement (AFCCDD-TN-60-33) to ECPX 0027 documents the earlier work effort; it is cited in ref. 1 of the current report.) The experiments undertaken here were performed by the IBM Human Factors Department under the terms of Air Force Contracts 30(635)-1404 (ECPX 0027) and AF30(635)-3130. The dual objective of the two experiments was to further investigate techniques that would improve tracking and to determine quantitatively, if possible, the effects of clutter density on the detection of aircraft trails.

Project & Task: 1975-76891 Contract No. AF30(635)-3130
ASTIA No. 250788

(183)
AFCCDD-TN-61-20 March 1961

Shettel, Harris H.; Lindley, Richard H. (American Institute for Research)

AN EXPERIMENTAL COMPARISON OF TWO TYPES OF SELF-INSTRUCTIONAL PROGRAMS FOR A SAGE SYSTEM PAIRED-ASSOCIATE TASK

A problem in implementing self-instructional methodology for the training of SAGE and other L-system operators is the wide variety of behaviors and skills required by these operators and the wide variety of training techniques available to the self-instructional programmer for teaching these skills and behaviors. The study was done to determine optimal presentation methods for teaching the phonetic alphabet which is characteristic of much of the symbolic material which forms a part of L-system operator tasks. This discrete-item, paired-associate material was prepared in six different formats: (1) long continuous-discourse program, overt responses; (2) short continuous-discourse program, overt responses; (3) same program as (2) but using covert responses; (4) flash cards, time limited, covert responses; (5) flash cards, time unlimited, covert responses; and (6) flash cards, time limited, with drop-out of mastered items. Each program was given to ten college undergraduate subjects. The least number of errors on two immediate post-tests were made by the subjects who were given the long program and any of the flash card programs. The most errors were made by subjects receiving either short program. The three flash card groups led to high levels of performance in short periods of time (14 minutes) as compared with the long, overt response program (40 minutes). Thus, when preparation time, training time, and amount learned are all considered, conventional self-instructional programming methods appear to have no advantage over simpler presentation techniques for teaching discrete-item, paired-associate SAGE subject matter.

Project & Task: 1975-76892 Contract No. AF19(604)-5951
ASTIA No. AD260320

(184)
AFCCDD-TN-61-26

Psychological Research Associates

A SELF-TUTORING COURSE FOR ON-SITE TRAINING IN SAGE AN/FST-2 TROUBLESHOOTING

This is a self-tutoring course in four volumes: Vol. I, Textbook; Vol. II, Answer Book; Vol. III, Diagram Book; Vol. IV, Course Monitor Manual.

Project & Task: 1975-76892 Contract No. AF19(604)-5616
ASTIA No. AD404655

(185)
AFCCDD-TN-61-27 February 1961

Shettel, Harris H.; Lumsdaine, Arthur A. (American Institute for Research)

PRINCIPLES OF PROGRAMMING AS APPLIED TO THE DEVELOPMENT OF TWO SELF-INSTRUCTIONAL PROGRAMS FOR SAGE OPERATORS

The essential characteristics of the Track Monitor and Intercept Director tasks, for which self-instructional programs were developed, are described in behavioral terms. These characteristics were identified as including the following kinds of behaviors and skills: Job knowledge (academic), decision-making, problem-solving, perceptual, positional-motor, symbol identification, and sequential. Emphasis is placed on these task characteristics only in so far as they had implications for the programming methodology used. The rationale developed for relating this programming methodology to the identified task characteristics is discussed in detail in terms of the following specific programming variables: form of response, type of feedback, method of cueing, size of step, organization of frames, and branching. Selected frames from the Track Monitor and Intercept Director programs are shown and discussed as examples of the application of each of these variables to various task characteristics. In addition, the organizational structure, the distribution of written (and other) responses, and the use of branching sequences is discussed for each program. A study done to compare the effectiveness of two methods (i. e., flash card techniques and continuous-discourse self-instructional programs) of presenting discrete-item, paired-associate material (e. g., the phonetic alphabet) is briefly reported. The way in which the results of this study, which supported the use of the flash card techniques, were applied to the development of the two programs, is discussed. Also presented are implications derived from the development and use of these programs for improved programming techniques as applied to SAGE and related L-system tasks.

Project & Task: 1975-76892 Contract No. AF19(604)-5951
ASTIA No. AD260316

(186)
AFCCDD-TN-61-29 November 1960

IBM Command Control Center

PROGRAM NOTES, LISTINGS, AND FLOW DIAGRAMS FOR HUMAN FACTORS ENGINEERING STUDIES

This document contains a number of program notes and listings together with explanations of equipment modifications and descriptions of the experiments performed by the IBM Human Factors Department under Air Force Contract 30(635)-1404 (ECPX 0027). All of the studies were performed using the second prototype of the SAGE Computer (AN/FSQ-7), better known as XD-2.

Project & Task: 1975-76891 Contract No. AF30(635)-1404
ASTIA No. AD252990

(187)
AFCCDD-TN-61-30 April 1961

Shettel, Harris H.; Angell, David; Lumsdaine, Arthur A. (American Institute for Research)

HANDBOOK FOR THE PREPARATION OF SELF-INSTRUCTIONAL MATERIALS FOR SAGE OPERATORS

This Handbook is designed to provide specific nontechnical guidance to those persons who want to know more about the procedures and techniques generally recognized as important in the development of self-instructional materials and programs. Emphasis is placed on program development rather than on equipment (teaching machines). Following a general discussion of the self-instructional concept and the ways in which it differs from the more traditional forms of training are specific discussions of the various steps which should be followed in preparing self-instructional materials. Included are sections on: (1) Statement of program objectives, (2) Analysis of the task, (3) The organization of materials, (4) The techniques used in frame development (i. e., size of frame, selection of responses, use of cues, use of feedback, use of review and repetition, sequencing of frames), (5) Editing and tryout of program materials, and (6) Program revision and up-dating. Also included are discussions of the use of simulated job-operator equipment as an integral part of the self-instructional program and the implications that program presentation methods (devices) have on programming techniques. The experience gained in the development of two self-instructional programs for the SAGE Track Monitor and Intercept Director Operator positions is used as a general guide for discussing programming techniques. Frames from both of these programs are used as specific examples of the application of these various techniques.

Project & Task: 1975-76892 Contract No. AF19(604)-5951
ASTIA No. AD260317

(188)
AFCCDD-TN-61-31 May 1961

Gundy, Richard F. (Indiana University)

REMARKS ON BIRDSALL'S DETECTION OF A SIGNAL SPECIFIED EXACTLY WITH A NOISY STORED REFERENCE SIGNAL

The existence of an optimum decision procedure for a signal specified exactly with reference to a noisy stored reference signal is reexamined. It is shown that, within the framework of the theory of signal detectability, no such procedure exists.

Project & Task: 7684-76841 Contract No. AF19(604)-1962

(189)
AFCCDD-TN-61-32 March 1961

Pollack Irwin (Operational Applications Laboratory)

ON THE COMBINATION OF INTENSITY AND FREQUENCY DIFFERENCES IN AUDITORY DISCRIMINATION
(J. Acoust. Soc. Am., Vol. 33, No. 8, 1141-1142, Aug 1961)

The results of Harris and collaborators on the discrimination of combinations of auditory intensity and frequency differences were examined with reference to four models of auditory discrimination. Of the four, the most successful prediction of the effect of combinations of intensity and frequency differences assumes a recognizable threshold for each of the stimulus variables.

Project: 7682

(190)
AFCCDD-TN-61-33 March 1961

Moser, Henry M.; Michel, John F.; Fotheringham, Wallace C. (Ohio State University)

INTELLIGIBILITY AND CONFUSABILITY OF VOWELS AND DIPHTHONGS UNDER VARIOUS CONDITIONS OF QUIET AND NOISE

Sixteen English vowels and diphthongs were recorded by four male and four female speakers. For each vowel and diphthong, 120 responses were obtained from a panel of six phonetically trained listeners at several levels of noise and quiet; each of five levels of noise were matched for listening difficulty with five levels of quiet. The levels of difficulty ranged from approximately 25 percent to 85 percent correct. The results on vowel-diphthong intelligibility support the conclusions that vowels and diphthongs (1) are significantly different in intelligibility; (2) have a fairly stable order of intelligibility, similar in noise and quiet and among the eight speakers, though more stable among speakers of the same sex; (3) improve in intelligibility at different rates as listening conditions are improved; and (4) are more intelligible from male speakers. In regard to vowel and diphthong confusability, results support the conclusions that (1) a great many significant confusions exist among the vowels and diphthongs under fairly difficult listening conditions, (2) at least one significant confusion exists for each vowel and diphthong, (3) each vowel and diphthong is a significant confusion for at least one other vowel or diphthong, and (4) confusions bear a reciprocal relationship to one another.

Project & Task: 7684-76842 Contract No. AF19(604)-6179
ASTIA No. AD260556

(191)
AFCCDD-TN-61-34 December 1961

Pettie, Charles R.; Halsey, Rita M.; Smith, Wellington E. (IBM Command Control Center)

EFFECTS OF CLUTTER AND TRACK DENSITY ON TRACK MONITOR PERFORMANCE

SAGE Track Monitor performance is assessed using 81 simulated air situations balanced with respect to track density and clutter density. For each clutter density, parabolic equations describe trouble frames accrued (over a 10-minute period) as a function of tracks. Determinations are made of "Reinitiate" actions per corrected trouble, operator correction rate and operator increment to "system" trouble rate. Estimates of average time in trouble per track are provided. Operator performance is compared to that for a "perfect operator" and no operator. The technique and data presented here afford a means for evaluating modifications to the tracking function.

Project & Task: 1975-76891 Contract No. AF30(635)-3130 and AF30(635)-1404
ASTIA No. AD270569

(192)
ESD-TN-61-36 May 1961

Moser, Henry M.; Henderhan, Robert C. (Ohio State University)

CONSONANT INTELLIGIBILITY WITH SELECTED VOWELS IN QUIET AND NOISE

Nineteen consonants and the vowel in isolation were paired with the vowels [æ], [I], [e], and [o] to form CV and VC syllables. Two male and two female speakers recorded the stimuli. Responses to stimuli at five levels of low signal intensity were obtained from one panel of six phonetically trained listeners, and responses to the same stimuli in five levels of random noise from another panel of six listeners similarly trained. The results support the general conclusion that low signal intensity is a satisfactory substitute for masking noise in testing consonant intelligibility. Testing conditions of comparable difficulty produce approximately the same intelligibility values, similar spread of intelligibility values, and similar confusion frequencies. In regard to different vowels, all intercorrelations are significant regardless of test conditions; the correlations obtained under noise conditions are slightly higher than those obtained at low signal intensities. In both test conditions, the vowels [I] and [e] appear to affect consonant intelligibilities most similarly.

Project & Task: 7684-76842 Contract No. AF19(604)-6179
ASTIA No. AD248603

(193)
ESD-TN-61-37 May 1961

Moser, Henry M.; Fotheringham, Wallace C. (Ohio State University)

INTELLIGIBILITY OF BEGINNING AND ENDING CONSONANTS WITH THE VOWEL [I]

Consonants and consonant clusters with the vowel [I] were formed into CV and VC stimuli and were spoken by male and female speakers in random noise to phonetically trained listeners. The study provided the bases for the following conclusions: (1) the rank order of consonant intelligibility varies with speakers but is significantly more stable for initial consonants and for speakers of the same sex. (2) Final consonants are more intelligible than initial consonants. (3) Confusions among initial and final consonants are similar. (4) Confusions are mo frequent among members of the same class of consonants; e. g. stops, fricatives, nasals, etc. Apparently, different places of articulation (labial, dental, alveolar, etc.) do not provide a sufficient basis for distinguishing members of a class. (5) Consonant clusters tend to be less intelligible than single consonants. (6) Confusions for consonant clusters are similar in class to the component sounds of a cluster. (7) CVC units formed from the most intelligible CV and VC syllables are significantly more intelligible than units formed from the least intelligible syllables. (8) It appears that, given the intelligibility values of consonants composing a cluster, no definitive prediction can be made of the intelligibility of the cluster.

Project & Task: 7684-76842 Contract No. AF19(604)-6179
ASTIA No. AD284602

(194)
ESD-TN-61-38 May 1961

Moser, Henry M.; Gardner, Harvey J. (Ohio State University)

INFLUENCE OF CONSONANTS ON THE RECOGNITION OF THE VOWELS [u] AND [i]- A STUDY OF INTERNATIONAL PRONUNCIATIONS FOR TWO AND THREE

The purpose of this study was to investigate a methodology proposed to solve the auditory confusion between the vowels [u]and [i]. This methodology utilizes the different influences exerted by consonants on recognition of the adjacent vowel, and the effects of foreign dialect on these influences. It was hoped that the results would provide alternative pronunciations of superior intelligibility for the numbers TWO and THREE.

Project & Task: 7684-76842 Contract No. AF19(604)-6179
ASTIA No. AD260557

(195)
ESD-TN-61-39 March 1961

Moser, Henry M.; Fotheringham, Wallace C.; Henderhan, Robert C. (Ohio State University)

SINGLE-VOWEL INTELLIGIBILITY TESTS

Two studies are reported in which lists of words and syllables, each constructed around a single vowel,were compared with PB word lists. In the first study, three speakers recorded the four W-22 PB word lists and eight different single-vowel word lists composed of words of comparable word frequency to the W-22 words and which were phonetically balanced according to the distribution of consonants in English monosyllables (VPB lists). Three hundred fifty-eight Army ROTC students listened to representative PB and VPB lists in white noise. It was found that (1) VPB lists differ significantly from each other in intelligibility; (2) VPB lists are more difficult than the W-22 lists; and (3) VPB lists are more sensitive measures of interspeaker intelligibility differences than the W-22 lists. In the second study, forty air traffic controllers were tested with (a) an expanded single-vowel word list composed of different beginning and ending consonants and consonantal combinations present in English, (b) syllabic lists derived from word-halves of the same single-vowel word list, and (c) a Harvard PB list. The word and syllabic lists were received and transcribed by a panel of phonetically trained listeners at S/N ratios of plus 14 and plus 18 db, respectively. It was found that (1) the expanded single-vowel word list is much more difficult than the PB list, (2) syllabic lists are reasonably accurate predictors of consonantal errors in words of which they are a part, and (3) syllabic lists and the PB list are not highly related as indices of intelligibility. Furthermore, the syllabic lists appear to provide an instrument of tremendous potential for diagnostic testing and training purposes.

Project: 7684-76842 Contract No. AF19(604)-6179
ASTIA No. AD269666

(196)
ESD-TN-61-40 May 1961

Moser, Henry M.; Fotheringham, Wallace C.; Gonzalez, Guillermo A. (Ohio State University)

AN ANALYSIS OF THE PURPOSES OF AIR-TRAFFIC CONTROL MESSAGES

A sample of 8,861 air-traffic control messages from Idlewild Airport, N. Y., Miami, Mexico City, and Accra, Ghana air-traffic control facilities were transcribed from tapes. From an analysis of communication context, the purposes of the messages were inferred and categorized. Of this larger sample, representative subsamples from each facility, totaling 873 messages, were selected for further analysis of message length and origin. The findings support the following conclusions: (1) The dominant message purposes of air-traffic controllers involve regulation, control, instruction, and advice; pilot messages emphasize acknowledgement, confirmation, request, and provision of non-directive information. (2) Air-traffic controller messages are significantly longer and occur less frequently in R/T communication than pilot messages. (3) Air-traffic controller messages are about equal in message length, while pilot messages vary and are shortest in airport control communication. (4) American facilities employ a greater proportion of messages concerned with aircraft position, while foreign facilities employ a greater proportion of readbacks and acknowledgments. (5) Air-traffic controller messages are significantly longer in foreign facilities than in American facilities. (6) Non routine and negative statements, and request for message repetition occur quite infrequently at all facilities sampled.

Project & Task: 7684-76842 Contract No. AF19(604)-6179
ASTIA No. AD260038

(197)
ESD-TN-61-41 April 1961

Moser, Henry M.; Fotheringham, Wallace C.; Gonzalez, Guillermo A. (Ohio State University)

VARIANCE IN THE RATE OF SPEAKING BY PILOTS AND CONTROLLERS IN COMMUNICATING TO U. S. AND FOREIGN LISTENERS

Recordings of air traffic messages at foreign and domestic international airports were examined to determine if pilots and controllers adjust their rate of speaking in terms of perceived listener needs. It was found that pilots and controllers use a slower rate when speaking in English to listeners whose native language is not English. In general, the data supports a conclusion that pilots and controllers adjust rate of speaking to match perceived listener needs.

Project & Task: 7684-76842 Contract No. AF19(604)-6179
ASTIA No. AD269667

(198)
AFCCDD-TN-61-42 March 1961

Moser, Henry M.; Leon, Pierre (Ohio State University)

THE RECOGNITION OF FRENCH VOWELS BY AMERICAN LISTENERS

The effect of a French accent on the intelligibility of English one-syllable words was studied to predict probable errors in voice communication from French speakers to American listeners. It was found that (1) French sounds cannot be presumed to be equivalent to those of English, (2) certain errors can be predicted when the French phonetic pattern is substituted for English, (3) single vowels are less intelligible than diphthongs pronounced as separate sounds, and (4) special care must be taken in teaching the English vowels [ɔ], [ʌ], [ɪ], [u], [æ], and [i] to speakers whose native tongue is French.

Project & Task: 7684-76842 Contract No. AF19(604)-6179
ASTIA No. AD260558

(199)
ESD-TN-61-47 March 1961

Shettel, Harris H.; Lumsdaine, Arthur A. (American Institute for Research)

CHARACTERISTICS OF SELF-INSTRUCTIONAL DEVICES TO MEET TRAINING REQUIREMENTS FOR THE SAGE TRACK MONITOR, INTERCEPT DIRECTOR, AND RELATED SYSTEM-OPERATOR POSITIONS

An important consideration in assessing the feasibility of using self-instructional programs for on-the-site training of SAGE and other L-system type operators is the selection of appropriate self-instructional and ancillary equipment. A statement of functional equipment requirements found to be congruent with the SAGE Track Monitor and Intercept Director self-instructional programs is presented. Self-instructional device components are described and evaluated in terms of these requirements. In the field testing of the programs, the basic device was, with a few noted exceptions, found to meet most of the essential requirements. An alternative component was also used in the field tests and is briefly described. The basic device configuration used included console mock-ups, prepared as integral parts of the two self-instructional programs. They provided simulation of all essential button and switch insertion actions, and also simulated the flashing Situation Information Display on which is presented the various symbols and data which form an essential part of both the Track Monitor and Intercept Director tasks. A general discussion of the roles that devices can play in the implementation of on-the-site training, including the free time, unmonitored game-type self-training devices, as well as the more structured training emphasized in the present programs, is related to the specific approach taken in the development of the two devices used in this study. Recommendations for devices more congruent with L-system training needs include the possible application of system computers to the presentation and evaluation of self-instructional programs.

Project & Task: 1975-76892 Contract No. AF19(604)-5951
ASTIA No. AD260318

(200)
ESD-TN-61-48 April 1961

Marks, Melvin R.; Lawrence, Kenneth A.; Warburton, George B. Jr. (Psychological Research Associates)

PERFORMANCE TEST DEVELOPMENT FOR THE INITIATION SUPERVISOR/TRACK INITIATOR POSITIONS IN SAGE

This report describes the development, administration and analysis of individual at-the-console performance tests for the positions of Track Initiator and Initiation Supervisor in the SAGE system. The tests were shown to be independent of sector geography, reliable, valid and acceptable to operating personnel. It appears that a test development program based on these tests as prototypes is feasible.

Project & Task: 7684-76892 Contract No. AF19(604)-5616
ASTIA No. AD255581

(201)
ESD-TN-61-49 April 1961

Marks, Melvin R. (Psychological Research Associates)

A REVIEW OF RESEARCH ON PERSONNEL EVALUATION TOOLS FOR THE SAGE SYSTEM

This report reviews and summarizes the role of personnel evaluation in command and control systems in terms of R&D work under contract AF19(604)-5616 by Psychological Research Associates (PRA), a division of the Matrix Corporation. Studies are discussed which involve paper-and-pencil tests, performance tests and ratings as potential techniques. Particular attention is given to at-the-console performance tests.

Project & Task: 1975-76892 Contract No. AF19(604)-5616
ASTIA No. AD255580

(202)
ESD-TN-61-50 March 1961

Brown, Charles R.; Forsyth, Daniel M. (Operational Applications Laboratory)

A NON-LINEAR VISUAL PHENOMENON

The response of the visual system to intermittent stimulation at rates above the fusion point is generally considered to be independent of frequency, that is, linear with respect to time-average luminance. However, trains of 1000 light pulses per second alternated successively with trains of 500 light pulses per second may be perceived as flickering even though the time-average luminance is the same in each train.

Project: 9670

(203)
ESD-TN-61-51 March 1961

Shettel, Harris H. (American Institute for Research)

EVALUATION OF TWO PROTOTYPE SELF-INSTRUCTIONAL PROGRAMS COVERING BASIC JOB KNOWLEDGE FOR SAGE TRACK MONITOR AND INTERCEPT DIRECTOR OPERATOR POSITIONS

A short description of the Track Monitor (TM) and Intercept Director (IND) self-instructional programs and materials, covering basic job knowledges and skills, is followed by a detailed examination of the results obtained from on-the-site field trials of the completed programs. Three groups of trainees completed each program: (1) naive trainees who had no SAGE experience at all; (2) cross-trainees who were proficient in other areas of SAGE but who had no TM or IND experience; and (3) new trainees who had received TM or IND training but had very limited experience on the job. A fourth group of experienced TM and IND personnel were given the proficiency tests but did not participato in the training programs. Proficiency test results and opinion questionnaire results for all training groups are presented in detail; other pertinent data, such as training time, response errors and experience levels of the trainees, are examined. Relationships among some of these factors are tested and discussed. All training groups averaged 83% on the proficiency tests. Training time averaged 15 hours for the TM program and 19 hours for the IND program. Experienced personnel scored an average of five percentage points lower on the proficiency tests than the new and cross-training groups in both programs; they average five percentage points higher than the naive training groups for both programs. These results support the feasibility of using self-instructional materials of the type described for on-the-site initial training, cross-training, and transition training purposes. The programs are critically evaluated and implications are drawn from the field trial results for the future application of similar programs in military settings.

Project & Task: 1975-76892 Contract No. AF19(604)-5951
ASTIA No. AD260321

(204)
ESD-TN-61-52 March 1961

Shettel, Harris H.; Angell, David; Fazio, Janet L.; Lindley, Richard H.; Lumsdaine, Arthur A. (American Institute for Research)

TRAINING REQUIREMENTS FOR THE DEVELOPMENT OF PROTOTYPE SELF-INSTRUCTIONAL PROGRAMS COVERING BASIC JOB KNOWLEDGE FOR SAGE TRACK MONITOR AND INTERCEPT DIRECTOR OPERATOR POSITIONS

This report describes the steps and procedures used in analyzing the Track Monitor and Intercept Director tasks in order that appropriate self-instructional training programs covering basic job knowledge could be prepared for each of these two SAGE operator positions. It presents the rationale for the categorization of each task into segments and the ultimate ordering and structuring of these segments in the final self-instructional programs. Also described are methods by which changes in the self-instructional materials were incorporated in order to account for new and/or modified job procedures which result from SAGE model changes. Additional suggestions for accommodating changes are made. Two "Primers", one covering basic knowledges and skills needed for the Track Monitor position and the other covering the basic knowledges and skills needed for the Intercept Director position, were prepared as source documents for the training programs. Excerpts from these documents are included in this report. The complete documents are attached to this report as separately bound Appendices 1 and 2, and are available for limited distribution only.

Project & Task: 1975-76892 Contract No. AF19(604)-5951
ASTIA No. AD260315

(205)
ESD-TN-61-53 December 1960

Nieder, Philip C.; Neff, William D. (University of Chicago)

AUDITORY INFORMATION FROM SUBCORTICAL ELECTRICAL STIMULATION IN CATS (Science, Vol. 133, No. 3457, 1010-1011, Mar 31 1961)

Animals trained to respond to sound stimuli were found to perform the learned response when they were electrically stimulated through electrodes chronically implanted in subcortical structures of the auditory pathway. Other animals trained to respond to electrical stimulation of subcortical auditory structures showed differential transfer effects depending on the positions of the stimulating electrodes.

Project & Task: 9670-96703 Contract No. AF19(604)-5526
ASTIA No. AD261392

(206)
ESD-TN-61-54 May 1961

Finck, Alfred (Operational Applications Laboratory)

LOW-FREQUENCY PURE TONE MASKING (J. Acoust. Soc. Am., Vol. 33, No. 8, 1140-1141, Aug 61)

Binaural masked thresholds from 50 cps to 4800 cps were measured using low-frequency (10, 15, 25, 30, and 50 cps), high-intensity (100, 115, and 130 db SPL) pure tones. The results obtained for 5 listeners demonstrate a broad masking spread with masking peaks for 130-db SPL pure tones.

Project: 7684

(207)
ESD-TN-61-56 April 1961

Green, David M. (Massachusetts Institute of Technology)

SOME COMMENTS AND A CORRECTION OF "PSYCHOACOUSTICS AND DETECTION THEORY" (J. Acoust. Soc. Am., Vol. 33, No. 7, 965, Jul 1961)

The author comments on two items in an earlier paper entitled, "Psychoacoustics and Detection Theory" in order to avoid misunderstanding. (See D. M. Green, J. Acoust. Soc. Am., 1189, Vol. 32, 1960). (1) The function relating the percentage of correct detection responses to the physical intensity of the stimulus is called the psychophysical function. Elsewhere in the literature this function is more often called the psychometric function. A discussion follows and the author is open to suggestions for change in terminology. (2) Remarks are on the neural quantum theory. The author asserted that data that appear to indicate a two-quantum observer when plotted against pressure units cannot be interpreted as any kind of quantum observer when plotted against energy units. There is however, a very straight forward interpretation of the scales of pressure and energy that makes this assertion incorrect. An explanation follows.

Project & Task: 7682-76822 Contract No. AF19(604)-7459
ASTIA No. AD269860

(208)
ESD-TN-61-57 May 1961

Kidd, J. S. (Ohio State University)

WORK TEAM EFFECTIVENESS AS A FUNCTION OF MECHANICAL DEGRADATION OF THE INTRATEAM COMMUNICATION SYSTEM

A simulated radar air traffic control task was used as a setting for assessing the effects on team performance of various types of mechanical degradation of the communications subsystem. Three experiments were performed. In the first, channel noise, signal-to-noise ratio, and traffic density factors were evaluated. While no interaction between noise and traffic density was observed, it was clear that maintaining a high S/N ratio could prevent most of the deleterious effects of high noise levels. A second experiment compared various frequency pass band conditions with the outcome revealing that the higher frequencies are most susceptible to interference. The third experiment compared degree of channel interruption and evaluated techniques for overcoming this form of interference. Overall results indicate the importance of feedback and the role of sender-receiver cooperation in overcoming communications barriers.

Project & Task: 7684-76847 Contract No. AF19(604)-6665
ASTIA No. AD259082

(209)
ESD-TN-61-59 June 1961

Operational Applications Laboratory

PLANS FOR MAN COMPUTER COMMUNICATIONS RESEARCH USING THE RELIABILITY TEST ASSEMBLY COMPUTER AND THE ADVANCED DISPLAY CONSOLE AS RESEARCH TOOLS

The advanced display console and RTA Computer developed under SAGE II contracts will be modified for use in man-machine communications experiments. Man-machine communication procedure will be studied in five aspects: (1) preparation of data to make up visual messages, (2) presentation of the messages, (3) retrieval of data not already displayed, (4) choice behavior of the man, and (5) processing of the man's output. Present scheduling indicates full availability of the equipment for communications experiments by 1 Feb 1962.

Project & Task: 9678-96781
ASTIA No. AD260505

(210)
ESD-TN-61-61 June 1961

Hodge, Milton H.; Piercy, Mary L.; Crawford, Morris J. (University of Georgia)

THE CONSTANT-RATIO RULE AND LIFTED WEIGHTS

The present experiment was designed to evaluate a model of choice behavior, the constant-ratio rule, with a single dimensional stimulus ensemble of lifted weights. The results indicate that the rule can successfully predict the responses made to the stimulus objects. The concepts of stimulus and response confusion are advanced to explain the results.

Project & Task: 9670-96706 Contract No. AF19(604)-7299
ASTIA No. AD264314

(211)
ESD-TN-61-62 1961

Adams, Jack A.; Stenson, Herbert H.; Humes, John M. (University of Illinois)

MONITORING OF COMPLEX VISUAL DISPLAYS - II EFFECTS OF VISUAL LOAD AND RESPONSE COMPLEXITY ON HUMAN VIGILANCE (Human Factors, Vol. 3, No. 4, 213-221, 1961)

A vigilance experiment was performed on the characteristics of visual monitoring behavior in complex tasks like those found in modern semi-automatic systems. The activationist hypothesis, which contends that human alertness is a function of stimulation level, served as framework for the experiment. Under investigation were sources of environmental and response-produced stimulation that might be related to human alertness. A simulated semi-automatic air defense surveillance task was used. Environmental stimulation was manipulated by requiring six or thirty-six visual stimulus sources to be monitored for a three-hour observation period. Response-produced stimulation was a function of response complexity. No vigilance decrement was found for percent of signals correctly detected. Response latency declined significantly, but slightly, for groups that had simple response conditions but not for groups with complex response requirements. Results were discussed in terms of issues in operationally defining sources of stimulation for the activationist hypothesis, and the cautions that must be observed in generalizing from the simple tasks of most vigilance experiments to the complex tasks of semi-automatic systems.

Project & Task: 1975-76893 Contract No. AF19(604)-5705

(212)
ESD-TN-61-63 July 1961

Baker, James D.; Whitehurst, Albert J. (Operational Applications Laboratory)

A COMPARISON OF TWO PROPOSED LOGIC SYMBOL TYPES FOR LEGIBILITY AND READABILITY DIFFERENCES

Two proposed logic symbol types were compared for legibility and readability differences. One symbol type, Shaped Symbols, used shaped forms to differentiate basic logical functions. The other symbol type, Block Symbols, utilized a specified alphabetic character inclosed within a defined area to denote logical functions. An unpublished legibility study was replicated and the results of both studies agreed. This agreement was largely attributed to constant, uncontrolled variables in both studies. A readability evaluation was conducted to functionally compare the two symbol types. The results tended to favor the use of Shape encoded symbols in situations where problem solving of functional and logical relationships, in the context of other essential information, is of prime concern and density of symbols is high.

Project: 9678
ASTIA No. AD264304

II

TECHNICAL REPORTS

(213)
HFORL-TR-54-5 January 1954

Pollack, Irwin (Operational Applications Laboratory)

THE ASSIMILATION OF SEQUENTIALLY-ENCODED INFORMATION: 5. BINARY-ENCODED MATERIALS

This paper presents a methodology for verbal learning based on the theory of information. The approach allows an objective qualification, in units not specific to the particular experimental operations considered, of (1) the learning materials employed (the informational input), (2) the information lost (the error output), and (3) the information gained (the difference between the informational input and information lost). The units are sufficiently general to allow for comparison of the results of a diversity of experiments. An illustrative experiment in learning designed to fulfill the requirements of the methodology, was reported and the results were briefly considered.

Project: 7682
ASTIA No. AD36076

(214)
HFORL-TR-54-6 January 1954

Sumby, William H.; Pollack, Irwin (Operational Applications Laboratory)

SHORT-TIME PROCESSING OF INFORMATION

This is one of a series of research reports from these laboratories concerned with the informational handling capabilities of human operators. In particular, it considers the reproduction of artificial language materials which approach, to various degrees of statistical approximation, everyday English. It is essentially methodological and will be of interest primarily to the research worker. Two procedures for varying the informational content of verbal materials are employed: (1) the sequential relationships among units are manipulated; and (2) the information of the units themselves is manipulated. In the first case, the time for processing the materials is approximately proportional to the information of the materials. That is, the materials are processed, approximately, at a constant informational rate. In the second case, the time for processing the materials is approximately independent of the information of the materials. That is, the materials are processed, approximately, at an informational rate proportional to the information of the materials. Are there other aspects of human operator performance which behave in this manner? Delayed recall behaves in a rather similar manner. For example, when the materials are sequentially-restricted, the percentage of items recalled is approximately proportional to the amount of information of the materials. And, when the size of vocabulary is manipulated, the number of items recalled is, within wide limits, nearly independent of the information of the materials. Whether this parallel reflects a general characteristic of human operator performance, or not, is difficult to say. The available evidence does not refute it. It fits into the current folklore of physical analogues of human operator performance which pictures the operator with a reasonably-large, easily-tapped, memory storage, and, as a 'wide-band' informational system. The results of the first experiment support the former picture; the results of the second experiment support the latter picture.

Project: 7682
ASTIA No. AD36075

(215)
AFCRC-TR-54-15 July 1954

Pollack, Irwin; Klemmer, Edmund T. (Operational Applications Laboratory)

VISUAL NOISE FILTERING BY THE HUMAN OPERATOR: II. LINEAR DOT PATTERNS IN NOISE

There are many situations in present day military communication networks where a human observer is used to "filter" information. In this role, the observer attempts to separate out irrelevant information from relevant information - or in the terms of the communication engineer, he attempts to separate a "signal" from "noise". In fact, because of his high flexibility, his relatively large and easily-tapped memory storage, and his poor performance as a straight transmission link, the human operator is believed to be much better suited to filtering-type operations than to straight transmission-type operations. In this experiment, we wanted to know how well a subject could locate a simple visual pattern (the "signal") when it was presented with extraneous visual information ("Noise"). The tests were carried out with varying amounts of noise information and with several different signals and exposure durations. Two general findings of this study appear, but are not necessarily, contradictory. This first concerns the information transmissions for specific sub-classes of patterns. Here, it was found that, at the highest noise levels, maximal transmission is obtained with one of the smallest information sub-classes. The second concerns the informational transmission for the entire series of patterns. Here, it was found that the transmission obtained with any restricted sub-class was less than that obtained with the entire series of two, three....eight-dot patterns.

Project: 7682
ASTIA No. AD53653

(216)
AFCRC-TR-54-16 July 1954

Pollack, Irwin; Klemmer, Edmund T. (Operational Applications Laboratory)

THE ASSIMILATION OF VISUAL INFORMATION FROM LINEAR DOT PATTERNS

The transmission of information from a simple linear display was investigated in the present study. The stimuli were patterns of filled and unfilled outlines (a binary or two-valued code) arranged along a line. These stimulus patterns were presented visually for short exposure durations to experimental subjects who attempted to reproduce the pattern. The major results were: (1) The information transmitted with this linear display increased as the number of filled spaces (out of a possible eight spaces) was increased to four, and decreased thereafter. (2) Errors in the reproduction of this simple linear visual display were systematic rather than random. (3) An arbitrary restriction of the total number of possible patterns to those with a fixed number of filled positions (e. g. only patterns with two filled positions out of eight spaces) decreased the average uncertainty of the response. However, this reduction in response uncertainty is considerably smaller than the reduction in the information of the source of stimulus patterns. The net effect is, thus, a decrease in information transmission with an arbitrary restriction of the class of possible patterns. (4) Marked serial position effects were obtained for short exposures of this linear display. Under the conditions employed, maximum error was obtained for display-positions to the right of the middle of the display. (5) As the duration of exposure of the display was increased, the information transmitted per stimulus presentation was increased. The relative improvement in transmission was independent of the order of analysis of the response. (6) A comparison of the informational transmission obtained with simple linear and area displays suggests that the "coordinality" of simple geometrical displays may determine the information transmitted under a given set of conditions. The "coordinality" is defined as the number of independent dimensions along which each element of the display varies summed over all independently varying elements.

Project: 7682
ASTIA No. AD53639

(217)
AFCRC-TR-54-50 April 1954

Klemmer, Edmund T. (Operational Applications Laboratory)

TABLES FOR COMPUTING INFORMATIONAL MEASURES

This report contains the following tables: Table of $\log_2 n$, Table of $n \log_2 n$, Table of $-p \log_2 n$, plus formulas for Computation of Information Measures and an Illustrative Example.

Project: 7682
ASTIA No. AD94179

(218)
AFCRC-TR-54-52 May 1955

Kryter, Karl D. (Operational Applications Laboratory)

SPEECH COMMUNICATION IN NOISE

A review and discussion of the research literature on speech communication in noise are presented in sections entitled: (1) Acoustical Characteristics of Speech; (2) Measurement of Speech Intelligibility; (3) Effects of Some Acoustical Factors upon Speech Intelligibility and (4) Practical Limitations on Speech Communications in Noise. Extensive references are presented at the end of the report.

Project: 7682
ASTIA No. AD68618

(219)
AFCRC-TR-54-53 December 1954

Klemmer, Edmund T. (Operational Applications Laboratory)

THE RATE OF HANDLING INFORMATION: THE EFFECT OF FORCED INTERMITTANCY IN A KEY PRESSING TASK

This study is concerned with the effect of regularly spaced short pauses in the stimulus sequence upon rate of information transmission through the human operator. Each stimulus was a single light chosen at random from five bulbs. The response was pressing one of five corresponding keys. The lights were flashed at regular cycling rates from 3 to 6 per second. The flashes were interrupted by pauses formed by the omission of one or more flashes in a row. The number of light flashes between pauses was varied from 1 to 50 in separate tests. The results obtained from two subjects suggest that the introduction of breaks into a continuous sequence will enable the operator to follow higher presentation rates but the improvement will only compensate for the loss of presented information during the breaks. This compensation was possible with pauses which occupied up to one-third of the total test time and of duration up to one-half second each. It is suggested that these results may not apply to sequences with sequential dependencies or in the case where anticipation is possible.

Project: 7682
ASTIA No. AD56088

(220)
AFCRC-TR-54-54 October 1954

Klemmer, Edmund T. (Operational Applications Laboratory)

THE INFORMATIONAL CONTENT OF POLAR COORDINATES

Polar coordinates have widespread usage on plotting boards and their associated communication systems. It has, therefore, seemed worthwhile to consider some properties of polar coordinates in terms of the amount-of-information measure. We have done this for the case in which a target is equally likely to appear anywhere on a circular area. Part I describes a small study involving the estimation of polar coordinates from a minimum grid display. The results are analyzed in terms of the average information transmitted by the angular and radial coordinates of each point. Part II presents a derivation of the relative amounts of information in the angular and radial polar coordinates of points drawn from a continuous uniform distribution. This result is compared to findings in Part I. Part III shows the application of the informational measure to a plotting board in which only a discrete number of target positions are considered. The implications for grid design and reading accuracy are discussed.

Project: 7682
ASTIA No. AD51873

(221)
AFCRC-TR-54-55 April 1953

Pollack, Irwin (Operational Applications Laboratory)

THE INFORMATION OF ELEMENTARY AUDITORY DISPLAYS. II (J. Acoust. Soc. Am., Vol. 25, No. 4, 765-769, Jul 1953)

Previous studies have shown that the amount of information transmitted with a simple one-dimensional auditory display is relatively small. This paper considers three conditions designed to increase the information transmission with elementary auditory displays. The three conditions or variables were (1) the frequency range of tones investigated; (2) the utilization of objective reference tones presented with the unknown tone; and (3) the "dimensionality" of the display - the number of independently varying stimulus aspects of the display. Little additional gain in information transmission is associated with the first factor; a moderate gain is associated with the second; and a relatively substantial gain is associated with the third.

Project: 7682
ASTIA No. AD53651

(222)
AFCRC-TR-54-57 January 1955

Pollack, Irwin (Operational Applications Laboratory)

VISUAL NOISE FILTERING BY HUMAN OPERATORS: I. SEQUENTIALLY ENCODED INFORMATION

One of the most important functions of human operators in communications-control systems is that of filtering relevant from irrelevant information. This report considers an informational approach to the study of filtering performance and an illustrative experiment designed in terms of this approach. Orderly sequences of dots, arranged as discrete approximations to continuous "flight paths" were perturbed randomly and were presented to experimental subjects. The task of the subjects was to recover the original flight path, either by reproducing the best estimate of the original path or by matching the best estimate of the path to one of a restricted number of paths. The major findings were: (1) Filtering performance deteriorates as the proportion of signal positions subjected to random perturbation is increased. The change in filtering performance is, however, not necessarily uniform with increasing perturbation. Sharp changes in filtering performance may be obtained over a critical range of perturbation levels. The region of these sharp changes is, in turn, a function of the difficulty of the filtering task. (2) Filtering performance deteriorates as the time available for inspecting the composite signal decreases. (3) Within the limits investigated, the amount of information processed by the subject, relative to the information presented, is approximately independent of the number of possible paths available to the subject for matching.

Project: 7682
ASTIA No. AD64490

(223)
AFCRC-TR-54-75 August 1954

Miller, George A. (Massachusetts Institute of Technology); Madow, William G. (University of Illinois)

ON THE MAXIMUM LIKELIHOOD ESTIMATE OF THE SHANNAN-WIENER MEASURE OF INFORMATION

The limiting form and the first two asymptotic moments of the sampling distribution of the maximum likelihood estimate of the Shannan-Wiener measure of amount of information per observation drawn from a multinomial distribution are determined. Also, approximations to the bias and the mean square error of the estimate are given.

Project: 7682 Contract No. AF18(600)-322
ASTIA No. AD47951

(224)
AFCRC-TR-54-76 September 1954

Egan, James P. (Indiana University)

PERSTIMULATORY FATIGUE AS MEASURED BY HETEROPHONIC LOUDNESS BALANCES (J. Acoust. Soc. Am., Vol. 27, No. 1, 111-120, Jan 1955)

Perstimulatory fatigue is the decrease in loudness of a steady auditory stimulus during its presentation. In the past it has been measured by requiring a simultaneous dichotic loudness balance between two pure tones of the same frequency, one in each ear. Under these conditions the listener hears a single phantom sound whose localization depends upon the relative intensities of the two tones. The present investigation shows that the process of localizing the sound image in making the loudness balance is not critical to the occurrence of perstimulatory fatigue. Two principal conditions were compared. In the first, the frequency of the comparison stimulus was the same as that of the fatiguing stimulus. In the second, the comparison and fatiguing stimuli differed sufficiently in frequency so that the listener always heard two pure tones which he could correctly localize in the two ears. It is concluded that the amount of perstimulatory fatigue is very nearly the same under these two conditions. In the early phases of the present research it was suspected that the loudness balances were influenced by absolute judgments of loudness. A procedure is developed which precludes the formation of a single absolute standard of loudness. This method results in greater measured fatigue than the usual procedure.

Project & Task: 7681-76814
ASTIA No. AD76345 Contract No. AF18(600)-571

(225)
AFCRC-TR-54-77 September 1954

Carterrette, Edward C. (Indiana University)

PERSTIMULATORY AUDITORY FATIGUE FOR CONTINUOUS AND INTERRUPTED NOISE (J. Acoust. Soc. Am., Vol. 27, No. 1, 103-111, Jan 1955)

Perstimulatory fatigue, or adaptation, is measured by a simultaneous loudness balance or median plane localization of a dichotically presented acoustic stimulus. After one ear has been stimulated for a period of time, it is usually found that the variable or comparison stimulus must be reduced below the prefatiguing intensity in order to maintain the loudness match or localization balance. Five observers made median plane localizations of a continuous 100-5000 cps band-pass noise before, during and after a seven-minute fatiguing period. The fatiguing stimuli were continuous noises at 30, 60, 87, and 100 db SPL, and noises interrupted at 1, 2, 5, 9, and 12.5 ips with both burst level and noise-time fractions held constant at 90 db SPL and 0.5, respectively. It was found that (a) the time required for fatigue to reach an apparent asymptote is at least seven minutes, about twice that required for pure tones; (b) the maximum fatigue increases with the intensity of the fatiguing stimulus and the function is positively accelerated; (c) for a fixed intensity of fatiguing noise, the maximum fatigue for the highest rate of interruption used (12.5 ips) is less than that obtained with a continuous noise having the same overall level (87 db). During the course of fatigue, the between-observer variations (standard deviations) of the balances tend to be greater than the within-observer variations; the reverse is true for the post-fatigue period.

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ASTIA No. AD90792

(226)
AFCRC-TR-54-78 March 1955

Thwing, Edward J. (Indiana University)

SPREAD OF PERSTIMULATORY FATIGUE OF A PURE TONE TO NEIGHBORING FREQUENCIES (J. Acoust. Soc. Am., Vol. 27, No. 4, 741-748, Jul 1955)

When a fatiguing tone is presented to one ear of an observer, and, after a period of time, a comparison tone of the same frequency is also presented to the other ear, the intensity of an equally-loud comparison tone is considerably less than the intensity of the fatiguing tone. This phenomenon has been referred to as perstimulatory fatigue. The present investigation was designed to determine the extent to which the perstimulatory fatigue induced by a pure tone spreads to neighboring frequencies. Perstimulatory fatigue was measured by means of a series of simultaneous dichotic loudness balances made prior to, during, and subsequent to stimulation by a fatiguing tone of 1000 cps at a SPL of 80 db. Test tones were the same in sound pressure as the fatiguing stimulus. When measuring fatigue at a frequency other than that of the fatiguing tone, the fatiguing stimulus was turned off for a 15-second interval. During this interval, a loudness balance was made at the frequency of the test tone. The findings demonstrate that maximum fatigue is produced at the frequency of the fatiguing stimulus. Fatigue falls off rapidly on both sides of this frequency at a negatively accelerated rate until at 100 cps and at 2500 cps little or no effect is evident. The gradients of perstimulatory fatigue are nearly symmetrical when plotted on a log-frequency scale.

Project & Task: 7681-76814 Contract No. AF18(600)-571
ASTIA No. AD90791

(227)
AFCRC-TR-54-79 May 1954

Egan, James P.; Carterette, Edward C.; Thwing, Edward J. (Indiana University)

SOME FACTORS AFFECTING MULTI-CHANNEL LISTENING (J. Acoust. Soc. Am., Vol. 26, No. 5, 774-782, Sep 1954)

Certain factors were investigated that affect the intelligibility of a speech message which is presented to a listener simultaneously with an interfering speech message. In two of the four experiments reported, filters were introduced into one of the two channels that carried the messages. Thresholds of perceptibility were not reliably decreased by moderate amounts of filtering of the received message. However, articulation scores were considerably increased by the use of a high-pass filter (500 cps) in either of the two channels. The great advantage of presenting one message to one ear and the interfering message to the other ear (dichotic presentation) was measured by changes in the thresholds of perceptibility and by articulation tests. Functional relations between thresholds of perceptibility for the message to be received and the intensity of an interfering signal were determined for both monaural and dichotic listening. In separate tests, noise was also used as the interfering signal. Dichotic reception permits a reduction in intensity of the received signal of about 30 db as compared with monaural reception. Articulation-gain functions demonstrated a similar advantage for dichotic over monaural listening. When the message to be received and the interfering message are monaurally received at equal intensities, the articulation scores for the designated messages are about 50 percent. If the message to be received is somewhat less intense than the interfering one, the cue value of the intensity difference offsets the increased masking of the less intense by the more intense message.

Project & Task: 7681-76814 Contract No. AF18(600)-571

(228)
AFCRC-TR-54-80 August 1954

Moser, Henry M.; Dreher, John J.; Patterson, Robert E. (Ohio State University)

SENTENCE ELEMENTS AND LISTENER RESPONSE

For tests of intelligibility subjects were distracted by a motor task that involved a continuous manual tracking of flashing lights while concurrently attempting to repeat flight commands and information under noise masking as given by the speakers. It was concluded that: (1) No statistical superiority (either verbatim or paraphrase) resulted from prefixing orders with the word "please". (2) A high correlation ($p=.95$) exists between verbatim and paraphrase scores, making the more useful paraphrase a sufficient measure of the listener's reception of connected discourse. (3) From paraphrase scores: (a) "Immediately" is inferior to "at once"; (b) "Above" is inferior to "over"; (c) "Below" is inferior to "under" and (d) "Here" is inferior to "read". (4) No differences in articulation score can be related to a word's root. Latin and Anglo-Saxon words appear to be equally effective. (5) The mode of utterance (i. e., command, question, or statement) does not affect its success in reception. (6) Commands are as effective without tag words as with them. (7) A fairly low but significant negative correlation existed between sentence length and successful reception in this study.

Project & Task: 7681-76813 Contract No. AF18(600)-316
ASTIA No. AD43634

(229)
AFCRC-TR-54-81 August 1954

Moser, Henry M.; Dreher, John J.; Adler, Sol (Ohio State University)

THREE-DIGIT NUMBER TELLING AND REPETITION METHODS

Three types of three-digit number telling were investigated: A. Single digit (e. g. Three-One-Four) B. Group (e. g. Three-Fourteen) and C. Full word form (e. g. Three Hundred Fourteen). These three basic telling forms were combined in Phases II and III as repetition forms, for example AC (which) represents the sequence of telling form A, the phrase "I say again", and the telling form C. The possible combinations of these would be AA, BB, CC, AB, AC, CA, BA, CB, and BC. The safest general rule to follow in telling three-digit numbers is to pronounce them as single digits (A). Under favorable listening conditions and when Americans are on both ends of the communication link, either the form (B) or full word form (C) does as well, but only under these two conditions. As soon as a moderate amount of noise is present or when foreign speakers are involved, the single-digit telling method is required for maximum efficiency. Repeating a number does virtually no good if the repetition is in the same form (viz. Three-One-Four, I say again, Three-One-Four). Changing the form of the repeated number helps if the single-digit and group style is coupled in either sequence (AC or CA). In general telling method B is definitely to be avoided. In only one condition does it perform satisfactorily, namely, when it follows method C in a repeated message. (Method B alone, repeated, or in combination with any other form, results in poor listener reception.) The performance of international listeners on repeat methods is consistent regardless of the nationalities of listener or speaker.

Project & Task: 7681-76813 Contract No. AF18(600)-316
ASTIA No. AD43633

(230)
AFCRC-TR-54-82 September 1954

Moser, Henry M.; Dreher, John J.; Adler, Sol (Ohio State University)

TWO-DIGIT NUMBER TRANSMISSION BY VOLUNTARY STUTTERING (J. Speech and Hearing Disorders, Vol. 20, No. 4, 388-392, Dec 1955)

Foreign and American Listeners heard two-digit numbers transmitted in two different ways; (1) normal delivery (one-two), and (2) voluntary stuttering (wuh-one---tuh-two). The signals were presented at five different S/N ratios and the articulation scores were compared for differences (1) at noise levels and (2) between methods. In both methods American listeners achieved significantly higher articulation scores than foreign listeners at four of the noise levels. Voluntary stuttering gave both groups significantly better results, with score improvement relatively increased as the S/N ratio made listening more difficult.

Project & Task: 7681-76813 Contract No. AF18(600)-316
ASTIA No. AD43631

(231)
AFCRC-TR-54-83 September 1954

Moser, Henry M.; Dreher, John J. (Ohio State University)

N-V ALTERNATE WORD INVESTIGATION

Reports of NECTAR-VICTOR word confusions have been registered by member nations of the International Civil Aviation Organization (ICAO). Several proposed alternates to NECTAR-VICTOR were considered as meriting intelligibility tests. From the tests it was concluded that: (1) NOTAM and VAMPIRE as an N-V combination would work as well as, but no better than, NECTAR and VICTOR. (2) Either NOTAM or VAMPIRE alone is not recommended. (3) The single substitution of NOVEMBER for NECTAR would be the most feasible single change. (4) The additional substitution of OZONE for OSCAR would eliminate the OSCAR-FOXTROT confusion as well as furnish an O word with an initial "oh" sound.

Project & Task: 7681-76813 Contract No. AF18(600)-316
ASTIA No. AD47722

(232)
AFCRC-TR-54-84 April 1955

Moser, Henry M.; Dreher, John J. (Ohio State University)

PHONEMIC CONFUSION VECTORS (J. Acoust. Soc. Am., Vol. 27, No. 5, 874-881, Sep 1955)

Test responses of listeners from 27 countries who were tested over a period of a year and a half on several versions of word spelling alphabets are examined to determine patterns of intraensemble confusion. On the word level, confusion seems to hinge on the accented vowel, and these confusions are stratified according to the articulatory position of the vowel. Greater discrimination for front vowels than for back is noted, as well as diminishing intraensemble confusion from high-to-low articulatory position. A method for computing confusion vectors is presented along with a rationale for increasing the phonemic stability of any particular set of words.

Project & Task: 7681-76813 Contract No. AF18(600)-316
ASTIA No. AD47620

(233)
AFCRC-TR-54-85 September 1954

Moser, Henry M.; Dreher, John J.; Patterson, Robert E.; Adler, Sol (Ohio State University)

SENTENCE FORM AND INTELLIGIBILITY (FLIGHT TRAFFIC INSTRUCTIONS)

This is a study of the intelligibility of typical flight traffic instructions employed by air traffic control tower operators in the United States handling international traffic. Analysis of the language of 14 of these air traffic control operators served as a basis for the test used. A "typical" script was constructed routing five aircraft through the complete cycle of preliminary check, warm up, take off, traffic, landing, and taxi. Two parallel forms of the script were made, one employing "telegraphese" the other written in "full dress" sentence form. Speakers were of five different nationalities including American. Listeners were 300 American senior ROTC college students. Speakers (tower operators) recorded one of each type of script. Each listener was provided with two test forms with appropriate blanks to be filled in. It was concluded from the test that: (1) No significant difference in reception scores of flight information was observed between full English sentence form and the abbreviated usage demonstrated in the ANC manual as practiced by several international towers in the United States. (2) No significant differences were registered by American listeners in respect to Spanish, French, German, British, or American speakers under a condition of moderate noise interference. Highest mean percent correct score was 53, 80 for those listening to the British speakers. (American speakers were heard by a separate international panel.)

Project & Task: 7681-76813 Contract No. AF18(600)-316
ASTIA No. AD47721

(234)
AFCRC-TR-54-86 September 1954

Moser, Henry M.; Dreher, John J.; Adler, Sol (Ohio State University)

FOUR-DIGIT NUMBER TELLING METHODS

Four types of four-digit number telling were investigated: (A) Single digit (e. g. One-Two-Three-Four); (B) Group (Twelve thirty-four); (C) Mixed (One, two-thirty-four); (D) Full word (One thousand two hundred thirty-four). American listeners handled all methods equally well when either Americans or foreigners were speaking. Foreign subjects, listening to Americans, did best with the single-digit method, worst with the full-word method. When listening to an international speaker panel, foreign listeners exhibited no differences with Methods A, B, or C, but again scored lowest with the full-word form.

Project & Task: 7681-76813 Contract No. AF18(600)-316
ASTIA No. AD47619

(235)
AFCRC-TR-54-87 December 1954

Egan, James P. (Indiana University)

INDEPENDENCE OF THE MASKING AUDIOGRAM FROM THE PERSTIMULATORY FATIGUE OF AN AUDITORY STIMULUS (J. Acoust. Soc. Am., Vol. 27, No. 4, 737-740, Jul 1955)

The loudness of a steady auditory stimulus declines during the first few minutes of the application of that stimulus. This decrease in loudness is so great that it is important to know whether or not the masked threshold also changes during the initial period of stimulation. In the present investigation the degree of perstimulatory fatigue and the amount of masking were both determined for the same stimulus. It is shown that the masked threshold is essentially independent of the duration of the masking stimulus.

Project & Task: 7681-76814 Contract No. AF18(600)-571
ASTIA No. AD90793

(236)
AFCRC-TR-54-88 November 1954

Moser, Henry M.; Dreher, John J. (Ohio State University)

A COMPARISON OF THREE N-WORD ALTERNATES IN THE MODIFIED ICAO ALPHABET

Twenty-six subjects representing 17 nationalities listened to speakers of 8 nationalities pronouncing random groups of words from the 4-word ICAO alphabet modification, including the alternate words NUGGET and NOVEMBER. NOVEMBER proved superior to NUGGET or NECTAR.

Project & Task: 7681-76813 Contract No. AF18(600)-316
ASTIA No. AD51620

(237)
AFCRC-TR-54-89 December 1954

Moser, Henry M.; Dreher, John J. (Ohio State University)

STANDARD PRONUNCIATION OF THE MODIFIED ICAO ALPHABET

Alternate pronunciations of alphabet words from the modified ICAO alphabet were compared. Speakers were of eight nationalities including the U. S. Listener groups tested were as follows: Group A, eleven females, American; Group B, 26 foreign nationals of 16 nationalities; Group C, 75 AFROTC seniors, American male. It was concluded that QUEBEC should be pronounced as Kwih-BECK or Kay-BECK and not as KEH-beck. FOX-TROT was preferred over FOX. Except for these observations, any pronunciation or stress on ICAO words within normal phonemic limits of user nations is acceptable for international communication.

Project & Task: 7681-76813 Contract No. AF18(600)-316
ASTIA No. AD54920

(238)
AFCRC-TR-54-90 December 1954

Moser, Henry M.; Dreher, John J.; Adler, Sol (Ohio State University)

A COMPARISON OF CIRCLE COUNTING TO THREE METHODS OF REPEAT TRANSMISSION OF THREE-DIGIT NUMBERS

Four methods of transmitting three-digit numbers were compared at four S/N ratios. These methods were: (1) Repeat method AC: "4-6-8, I say again, four hundred sixty eight". (2) Repeat method CA: "Four hundred sixty eight, I say again, 4-6-8". (3) Repeat method CB: "Four hundred sixty eight, I say again, four sixty eight". (4) Circle counting: "4-6-8, I count 4, 2-3-4; 6, 4-5-6; 8, 6-7-8". The latter method, which considers the 10 digits as arranged in a circle, identifies each digit by counting up to it with the two preceding: (for example 1, 9-0-1; 2, 0-1-2; 3, 1-2-3 etc). At all S/N ratios the circle counting proved significantly superior to any of the three repeat methods which were the best of nine possible types of repetition. Circle counting transmission is approximately 45% longer in time than any repeat method.

Project & Task: 7681-76813 Contract No. AF18(600)-316

(239)
AFCRC-TR-55-1 June 1955

Klemmer, Edmund T. (Operational Applications Laboratory)

RATE OF FORCE APPLICATION IN A SIMPLE REACTION TIME TEST

An electrical strain gauge was fitted to a pressure key and continuous force records were taken during a simple reaction time experiment. Various levels of holding force previous to stimulus onset were required of the subject with two widely different amounts of additional force for the response. It was found that pre-stimulus holding forces up to 20 ounces had little effect on either the slope or temporal position of the rate of force application curves. Thus, pre-stimulus holding force had little effect upon reaction time defined by a given additional force. However, the slope of the force vs time curves is such that reaction time differences of 0.04 sec may be obtained by changing the added force required of the response from 1 to 20 ounces.

Project & Task: 7682-76821
ASTIA No. AD68162

(240)
AFCRC-TR-55-2 March 1955

Klemmer, Edmund T. (Operational Applications Laboratory)

TIME UNCERTAINTY IN SIMPLE REACTION TIME (J. Exp. Psychol., Vol. 51, No. 3, 1956)

Six Ss were given two series of simple reaction-time tests. In the first series the effect of changes in mean foreperiod and foreperiod variability were systemmatically investigated. In the second series the effect of spacing between stimuli was studied with no warning signal. These tests were designed to determine the relation between RT and Ss' uncertainty about time of stimulus presentation. The results show that RT increases with foreperiod variability and with mean foreperiod above some small optimum value less than 1 sec. In a sequence of trials, the immediate foreperiod influences RT only if the previous foreperiod is different from it, and then only slightly. The striking finding in all tests with variable foreperiod is that the important determiner of RT is not the immediate foreperiod but rather the distribution of foreperiods within which it is embedded.

Project & Task: 7682-76821
ASTIA No. AD104616

(241)
AFCRC-TR-55-3 March 1955

Coonan, Thomas J.; Klemmer, Edmund T. (Operational Applications Laboratory)

INTERPOLATION AND REFERENCE MARKS IN READING A LINEAR SCALE AT BRIEF EXPOSURES

If unlimited time is available for reading a scale, greater accuracy in reading may be obtained by adding more reference marks up to the point where the limits of acuity are reached. However, in the case where viewing time is limited the addition of too many reference marks will lead to increased errors. The study reported here was designed to investigate the relation between reading accuracy and the number of reference marks under conditions of brief exposure. On the basis of the experiment discussed in the report the following tentative conclusions are suggested: (1) It appears that for any given exposure duration there is an optimum number of reference marks for maximum scale reading accuracy. This is the maximum number that can be used without errors of identification of the reference marks. (2) The efficiency of a particular scale may be determined by an analysis of the type of errors made in reading the scale. If all of the errors are less than the smallest subdivision, a larger number of scale marks may be used profitably. However, if many of the errors are as large as, or larger than, the smallest scale interval, the number of scale divisions should be reduced.

Project & Task: 7682-76821
ASTIA No. AD68165

(242)
AFCRC-TR-55-4 June 1955

Pickett, J. M.; Kryter, Karl D. (Operational Applications Laboratory)

PREDICTION OF SPEECH INTELLIGIBILITY IN NOISE

Several proposed methods for calculating what the effects of noise will be on speech intelligibility are evaluated. Among them are the Bell Telephone Laboratories (BTL) method and Octave Band Methods by Beranek and Strasberg. A new octave-band method of prediction is proposed.

Project & Task: 7681-76814
ASTIA No. AD69350

(243)
AFCRC-TR-55-5 June 1955

Pollack, Irwin (Operational Applications Laboratory)

SOUND LEVEL IDENTIFICATION AND INTERTRIAL STIMULUS VARIATIONS (J. Acoust. Soc. Am., Vol. 27, No. 6, 1222-1223, Nov 1955)

Sound level identification was examined for two restricted ranges of sound levels concurrently. The principal variable was the rate of shifting between the two restricted ranges. In general, identification performance decreases as the rate of shifting between the two ranges increases. However, because of the loss of stimulus information, the arbitrary restriction of the stimulus range results in a lower over-all information transmission than without the procedural restriction. An implication for the scaling of elementary aspects of auditory displays is discussed.

Project & Task: 7682-76824
ASTIA No. AD106180

(244)
AFCRC-TR-55-6 November 1955

Spieth, Walter (Operational Applications Laboratory)

ANNOYANCE THRESHOLD JUDGMENTS OF BANDS OF NOISE (J. Acoust. Soc. Am., Vol. 28, No. 5, 872-877, Sep 1956)

Annoyance threshold judgments were obtained by exposing an individual to noise for three minutes and asking him to adjust the intensity to the level which, if any louder, would annoy him if it were present most of the time where he was working. In one experiment, 21 people made judgments about 13 bands of noise which covered the frequency range of 50 to 13000 cps, and subsequently made sets of equal loudness matches. No differences were found between annoyance threshold curves and equal loudness curves. In a second experiment, each of 162 people made one annoyance judgment. When these annoyance thresholds were transformed into equivalent loudness terms, the resultant annoyance threshold curve varied reliably with frequency only in that the threshold on the highest band (6600-9000 cps) was reliably lower than those on lower frequency bands. Office workers who had once worked in noisy situations as well as those working in noisy situations at the time of the experiment gave thresholds about 15 db higher than did people who had only worked in office-type situations. Within a group who had worked only in quiet situations, those who tried to imagine themselves in an actual working situation gave thresholds that averaged about 15 db higher than the thresholds of those who did not.

Project & Task: 7681-76814
ASTIA No. AD126500

(245)
AFCRC-TR-56-1 August 1956

Klemmer, Edmund T. (Operational Applications Laboratory)

SIMPLE REACTION TIME AS A FUNCTION OF TIME UNCERTAINTY (J. Exp. Psychol., Vol. 54, No. 3, 195-200, Sep 1957)

Five Ss were given a set of simple RT tests specifically designed to test the hypothesis that a single-valued relation could be obtained between RT and the time uncertainty of the stimulus. This relation was shown to be approximately linear when time uncertainty is plotted as an informational measure. The slope of the RT-time uncertainty function averaged 18 msec. per bit of stimulus uncertainty which is less than the slope arising from RT experiments involving choice among several stimuli previously reported. Information transmitted in the time domain varied from less than one to more than five bits per stimulus over the 10 tests.

Project & Task: 7682-76821
ASTIA No. AD152656

(246)
AFCRC-TR-56-2 October 1956

Howes, Davis (Operational Applications Laboratory)

ON THE RELATION BETWEEN THE INTELLIGIBILITY AND FREQUENCY OF OCCURRENCE OF ENGLISH WORDS (J. Acoust. Soc. Am., Vol. 29, No. 2, 296-305, Feb 1957)

The threshold of intelligibility for a word in a wide-spectrum noise is shown to be a decreasing function of the frequency with which the word occurs in general linguistic usage (word frequency). The drop in threshold is about 4.5 db per logarithmic unit of word frequency. This rate is independent of the length of the word, although the thresholds for words of given frequency of occurrence are lower for long words. The effect of restricting the listener's alternatives in an intelligibility test to a specified number of words is calculated from this relationship. These calculations come within 1 db of published experimental data. Theoretical functions relating intelligibility threshold to word length are also calculated from the word-frequency effect, on the assumption that listeners can discriminate the length of a word at levels too low for it to be identified. These functions are in general agreement with the experimental results. Implications for intelligibility testing procedures are discussed.

Project & Task: 7682-76821
ASTIA No. AD98830

(247)
AFCRC-TR-56-52 April 1956

Corbin, Horace H.; Reese, Ellen P.; Reese, Thomas W.; Volkman, John (Mount Holyoke College)

EXPERIMENTS ON VISUAL DISCRIMINATION 1952-1955

The research summarized in this report investigates four areas of visual discrimination. (1) Judgment and scaling: The estimation of visual position and the visibility of stimuli in a large, homogeneous, unanchored field. The number of categories a subject will select to judge multi-modal frequency distributions as compared to rectangular distributions. The size of the constant error for the bisection of visual position. A comparison of two methods for scaling verbal items. (2) Subjective Statistics: Judgments of mean, median, range, and contingency. (3) Visual Grouping: The identification of groups of planes converging on a friendly target. (4) Judgment of Position after Enforced Delay: Research concerning what happens to an observer's judgment of visual position when he is forced to wait varying periods of time after the disappearance of a stimulus before judging its location in the visual field. The results of the 20-odd experiments investigating these problems include the following: (1) When subjects search a broad, blank, horizontal field for point-stimuli, they often miss those appearing at the sides. Under our experimental conditions, a 120-degree field of search is the maximum effective size. When subjects judge position stimuli in any number of categories they choose, multi-modal distributions of stimuli transmit more information than rectangular distributions. Subjects can bisect visual position with relatively small constant errors, a finding which supports the distinction between substitutive and additive discriminable aspects in psychophysics. A new method of scaling psychological magnitudes (first suggested by S. S. Stevens) seems to be superior to the familiar 7-point scale, especially in the spreading out of high ratings which are negatively skewed when the older rating scale is used. (2) Subjects can judge the mean, median, and range of distributions of position stimuli with considerable accuracy. They can also judge the relative frequency of two values of a single aspect quite accurately, with a standard deviation of approximately 5%. Within the range studied, the rate of presentation of the successive stimuli to be judged is not an important variable. When subjects are instructed to judge the relative frequency of two values of a single aspect for series which also contain values of another aspect which is not to be judged, the precision of the judgment decreases as the percentage of "distracting stimuli" increases. When subjects are presented with series containing two values each of two aspects and instructed to judge the relative frequency of all four values, the precision of the judgments is much less than for series containing values of only one aspect. Average judgments are fairly adequate, but variability is high. (3) The task of identifying a group of converging dots ("enemy planes") is extremely difficult. The speed of identification increases as the number of dots in the converging group increases. Other variables investigated did not affect the subjects performance. These include: display size, viewing distance, location of the point of convergence with respect to the center of the display, and angular dispersion of the converging group. (4) When subjects are required to locate a point of light after the light has disappeared and must delay their response for varying intervals of time, error and variability increase as the enforced delay in response time increases. The shape of the screen (whether flat or curved) on which the stimulus lights are projected produces different types of error. Two anchoring agents, one at either end of the stimulus range, reduce error and variability of the judgment. A single anchoring agent shifts the apparent position of the lights away from the anchor.

Project: 7682 Contract No. AF18(600)-344
ASTIA No. AD106182

(248)
AFCRC-TR-56-53 June 1956

Price, Harold E.; Older, Harry J. (Psychological Research Associates)

AUDITORY SIGNALS IN AIR FORCE WEAPONS SYSTEMS AND EQUIPMENT

This report contains the results of a survey conducted to determine: (1) The present status of the use of auditory signals in Air Force weapons systems and equipment. (2) The contemplated use of auditory signals in Air Force weapons systems and equipment. (3) Operational opinions of present and proposed auditory displays in Air Force weapons systems and equipment. (4) Recommendations for immediate application to auditory systems and recommendations for further research in the field of auditory displays. Information was collected using questionnaire techniques, interviews, examination of literature, and conferences. The information has been presented in such a manner that cross referencing may be done between types of auditory signals, purposes for which they are used, and weapons systems or equipment in which they are contained. Operational considerations relating to auditory signals are synthesized in a separate chapter. The final chapter contains recommendations suitable for immediate application and recommendations for further research.

Project & Task: 7681-76816 Contract No. AF19(604)-1576
ASTIA No. AD106839

(249)
AFCRC-TR-56-54 September 1956

Miller, George A. (Harvard University)

HUMAN MEMORY AND THE STORAGE ON INFORMATION (IRE Transactions of Information Theory, Vol. IT-2, No. 3, 129-137, Sep 1956)

The amount of selective information in a message can be increased either by increasing the variety of the symbols from which it is composed or by increasing the length of the message. Psychological experiments indicate that the variety of the symbols is far less important than the length of the message in controlling what human subjects are able to remember. Two messages equal in length but differing in the amount of information per symbol are equally easy to memorize. This fact provides an opportunity for the effective use of recoding procedures and reveals the mental economy involved in organizing the materials we want to remember. An apparent exception to the rule that length, not variety, is the limiting factor in human memory occurs in the case of redundant messages. If two messages of the same length differ because one contains redundancy familiar to the learner and the other does not, the redundant message will usually be easier to learn and remember. In terms of the theory of information, redundancy can be viewed equally well as a reduction in the information per symbol or as a reduction in the effective length of the message. Psychologically, however, these two alternatives are not equivalent; redundancy permits a reorganization into familiar sequences in a way that effectively shortens the length of the message and so makes it easier to memorize, but this is not psychologically equivalent to reducing the amount of information per symbol. It is as if each storage register could accept any one of a tremendous variety of alternative symbols, but the number of registers available was quite limited. If we use these registers to store binary symbols, the storage is inefficient. If we group the binary symbols into sequences, give each sequence a different name, and store the recoded names, we can make more efficient use of the registers. Familiar redundancy is helpful because it enables us to recode more efficiently. These results for human memory are all the more striking in view of the fact that the amount of information per symbol is a critically important variable controlling the accuracy of our perceptions.

Project & Task: 7681-76814 Contract No. AF33(038)-14343
ASTIA No. AD114120

(250)
AFCRC-TR-56-55 November 1956

Miller, George A.; Friedman, Elizabeth A. (Harvard University)

THE RECONSTRUCTION OF MUTILATED ENGLISH TEXTS (Information and Control, Vol. 1, No. 1, 38-55, Sep 1957)

The ability of human operators to correct mutilations in printed English texts was studied for a variety of mutilations. The average person, given limited time to work, will not be able to correct passages perfectly if more than 10% of the characters are mutilated; the job is most difficult if the mutilation consists of random substitutions of erroneous characters. With superior persons and unlimited time, however, it is possible to abbreviate passages as much as 50%, either by omitting alternate characters or by omitting all the vowels and the space between words. These results correspond to a lower bound of 60% for the redundancy of printed English.

Project & Task: 7682-76825 Contract No. AF33(038)-14343
ASTIA No. AD98832

(251)
AFCRC-TR-56-56 November 1956

Egan, James P. (Indiana University)

FINAL REPORT FOR CONTRACT AF18(600)-571

This report presents abstracts of the research accomplished at the Hearing and Communications Laboratory, Indiana University under contract number AF18(600)-571. These 21 abstracts are divided into four categories: (1) multi-channel listening, (2) the operating characteristic and the repetition of messages in speech communications, (3) poststimulatory auditory fatigue, and, (4) perstimulatory auditory fatigue.

Project & Task: 7681-76814 Contract No. AF18(600)-571
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(252)
AFCRC-TR-57-1 February 1957

Klemmer, Edmund T. (Operational Applications Laboratory)

TIME SHARING BETWEEN FREQUENCY-CODED AUDITORY AND VISUAL CHANNELS (J. Exp. Psychol., Vol. 55, No. 3, 229-235, 1958)

Performance on a high-speed key-pressing task was determined for situations in which S: (a) responded to a frequency-coded visual channel (color-coded); (b) responded to a frequency-coded auditory channel (tone-coded); (c) alternated regularly between the visual and auditory channels; (d) alternated randomly between the visual and auditory channels; and (e) responded to simultaneous visual and auditory channels presenting redundant stimuli. Mean reaction times were taken during all tests. Each of the above tests was given to 5 to 7 trained Ss with the following results: (1) The frequency-coded lights and tones were of approximately equal difficulty; two Ss doing significantly better on the tones, and two on the lights, and three showing insignificant differences. (2) Alternating between channels every 2.5 sec. resulted in little decrement in the light channel. The tone channel dropped 11% in percentage correct score, the two Ss who did better on the separate tone channel showing the largest drop. (3) Increasing the alternation rate to once every .5 sec. dropped percentage correct performance on both channels an additional 26%. (4) Random alternation between channels produced the same performance as regular alternation at the same mean rate. (5) Presenting redundant information in the two channels simultaneously resulted in higher performance than the better single channel for only two of five Ss. (6) The average reaction time was the same for the separate light and tone tests. Alternation between channels increased the reaction time but only by .02 sec. The redundant-simultaneous presentation gave a reaction time no different from the single channel which had the shorter reaction time in the separate tests.

Project & Task: 7682-76823
ASTIA No. AD110061

(253)
AFCRC-TR-57-2 February 1958

Klemmer, Edmund T.; Loftus, J. P. (Operational Applications Laboratory)

NUMERALS, NONSENSE FORMS, AND INFORMATION

Are arabic numerals seen and reported better than a random pattern of lines of similar complexity? How do numerals and the related class of forms compare with other classes of stimuli when performance is measured by the amount of information transmitted by S? How much more information can S perceive than transmit? To determine whether well-learned symbols are perceived, discriminated, and remembered better than nonsense forms, the stimuli used were a series of arabic numerals and a logically related class of nonsense forms presented tachistoscopically to a group of 10 Ss required to make discriminative responses.

Project & Task: 7682-76821
ASTIA No. AD110063

(254)
AFCRC-TR-57-4 September 1957

Pollack, Irwin (Operational Applications Laboratory)

SPEECH COMMUNICATIONS AT HIGH NOISE LEVELS: THE ROLES OF A NOISE-OPERATED AUTOMATIC GAIN CONTROL SYSTEM AND HEARING PROTECTION (J. Acoust. Soc. Am., Vol. 29, No. 12, 1324-1327, Dec 1957)

Two aids for hearing conservation, a noise-operated automatic gain control system and an insert ear protection, were evaluated in terms of their effect upon speech intelligibility. At high noise levels, these aids not only do not interfere with the speech intelligibility, they may substantially improve speech intelligibility while affording hearing protection.

Project & Task: 7684-76841
ASTIA No. AD110079

(255)
AFCRC-TR-57-5 October 1957

Pollack, Irwin (Operational Applications Laboratory)

LOUDNESS OF PERIODICALLY INTERRUPTED WHITE NOISE (J. Acoust. Soc. Am., Vol. 30, No. 3, 181-185 Mar 1958)

The burst level of a periodically, abruptly interrupted, white noise, necessary to match a continuous non-interrupted white noise in loudness, was examined over a wide range of interruption conditions. A procedure for calculating the required burst level, with knowledge only of the time-intensity characteristics of the interrupted noise, is outlined.

Project & Task: 7684-76843
ASTIA No. AD247768

(256)
AFCRC-TR-57-6 October 1957

Pollack, Irwin; Pickett, J. M. (Operational Applications Laboratory)

MASKING OF SPEECH BY NOISE AT HIGH SOUND LEVELS (J. Acoust. Soc. Am., Vol. 30, No. 2, 127-130, Feb 1958)

Speech intelligibility was examined at high noise levels for a range of speech and noise spectra. Over a wide range of conditions, deterioration of speech intelligibility was observed with a constant speech-to-noise (S/N) ratio at high noise levels. Little change in intelligibility was observed for over-all speech levels to 130 db in the absence of background noise. Control tests ruled out distortion within the equipment as the factor associated with the loss of speech intelligibility.

Project & Task: 7682-76821
ASTIA No. AD110086

(257)
AFCRC-TR-57-7 October 1957

Pollack, Irwin (Operational Applications Laboratory)

MESSAGE PROCEDURES FOR UNFAVORABLE COMMUNICATION CONDITIONS (J. Acoust. Soc. Am., Vol. 30, No. 3, 196-201, Mar 1958)

Several message procedures, designed to improve speech communications under extremely unfavorable speech-to-noise ratios, were examined. A message procedure based upon the informational principle of successive selections among a reduced number of alternatives was strikingly superior to a message procedure based upon the repetition of a single selection among a larger number of alternatives. Information, alone, is not the entire story because message diversity, without change of information, may produce nearly equivalent results.

Project: 7681, 7682, 7684
ASTIA No. AD110087

(258)
AFCRC-TR-57-8 October 1957

Pollack, Irwin; Tecce, Joseph (Operational Applications Laboratory)

SPEECH ANNUNCIATOR WARNING INDICATOR SYSTEM: PRELIMINARY EVALUATION (J. Acoust. Soc. Am., Vol. 30, No. 1, 58-61, Jan 1958)

The principle of a speech annunciator as a warning signal indicator was evaluated in three experiments against a master warning signal. With respect to two important criteria of performance (warning signal identification time and performance upon a concurrent visual-motor tracking test), the speech annunciator was clearly superior to the master warning indicator. With respect to two other criteria of performance (initial warning detection and performance upon a concurrent message-reproduction task), the speech annunciator was equivalent to the master warning indicator. The results suggest that a speech annunciator, perhaps coupled with a master indicator, may be a useful warning indicator system.

Project & Task: 7681, 7682-76823
ASTIA No. AD110088

(259)
AFCRC-TR-57-9 October 1957

Pollack, Irwin (Operational Applications Laboratory)

SPEECH INTELLIGIBILITY AT HIGH NOISE LEVELS: EFFECT OF SHORT-TERM EXPOSURE (J. Acoust. Soc. Am., Vol. 30, No. 4, 282-285, Apr 1958)

Successive word intelligibility tests were executed at a constant S/N ratio over a 13-min. period for a range of white noise levels between 45 and 130 db. Speech intelligibility declined over the test period as a result of continued exposure to noise levels of 115 db and higher. Interactions among different noise levels on successive tests, as evidenced by speech intelligibility scores in noise, was minimal when the noise levels were separated by less than 80 db.

Project & Task: 7684-76841
ASTIA No. AD110089

(260)
AFCRC-TR-57-11 November 1957

Pollack, Irwin; Decker, Louis R. (Operational Applications Laboratory)

CONFIDENCE RATINGS, MESSAGE RECEPTION, AND THE RECEIVER OPERATING CHARACTERISTIC (J. Acoust. Soc. Am., Vol. 30, No. 4, 286-292, Apr 1958)

A rating scale was added to the standard articulation test procedure in order to obtain independent information about a listener's criterion for message acceptance or rejection. We find that assignment of confidence ratings does not interfere with the accuracy of message reception. The form of the receiver operating characteristic—the relationship between correct confirmations and false alarms—yielded by the rating procedure is similar to that yielded by a binary decision of message acceptance or rejection. In addition, the confidence rating is directly related to the average accuracy of message reception. This relationship is relatively invariant over a range of speech-to-noise ratios.

Project & Task: 7682-76822
ASTIA No. AD110097

(261)
AFCRC-TR-57-12 January 1958

Sumby, William H.; Chambliss, Davis; Pollack, Irwin (Operational Applications Laboratory)

INFORMATION TRANSMISSION WITH ELEMENTARY AUDITORY DISPLAYS (J. Acoust. Soc. Am., Vol. 30, No. 5, 425-429, May 1958)

A procedure for transmitting the letters of the alphabet by tone-coded signals was examined in quiet and against a noise background. The procedure employed successive selections, each from among a small number of alternatives, in order to transmit a target vocabulary of 25 letters. Four stimulus variables: tonal frequency, sound level, location, and duration were examined, one at a time. Successive selections were made among two, three, and five alternatives per variable. The highest reception rate was obtained with a three-alternative, frequency-coded display. Reception of tone-coded signals in noise was nearly equivalent to that in the quiet, when the tonal signals were about 3 db above masked threshold.

Project: 7682
ASTIA No. AD146779

(262)
AFCRC-TR-57-50 June 1957

Egan, James P. (Indiana University)

MESSAGE REPETITION, OPERATING CHARACTERISTICS, AND CONFUSION MATRICES IN SPEECH COMMUNICATION

This report describes various terms, concepts, and functional relations that have been found useful in an analysis of certain aspects of the behavior of communication operators when they are attempting to transmit and to listen to the spoken word in the presence of noise. The notions described deal primarily with the decisions that are made by the operators themselves during communication as to their own accuracy in the transmission and the reception of messages. These decisions play an important part in the communication process; for it is usually a long time after a response to a message occurs before there is an objective check upon the operator's accuracy. The intimate relation of the confusion matrix to these processes is also explored. This report is intended to bring together in one place recent research at Indiana University on these problems.

Project & Task: 7684-76841 Contract No. AF19(604)-1962
ASTIA No. AD110064

(263)
AFCRC-TR-57-52 January 1957

Newman, Edwin B.; Miller, George A. (Harvard University)

A STUDY OF SEQUENTIAL REDUNDANCY AND SIMULTANEOUS REDUNDANCY

It is impossible to predict the success of voice communication solely on the basis of physical measurements of the speech signal and the communication link. It is necessary in addition to specify certain statistical and grammatical properties of the messages, for normal speech contains numerous protective devices to ensure that if information is lost by the destruction of one physical aspect of the signal, it still may be preserved redundantly in other aspects which survive transmission and suffice for correct reception. These protective devices can be classified as sequential redundancy and simultaneous redundancy. Both have been studied under this contract.

Project & Task: 7682-76825 Contract No. AF33(038)-14343
ASTIA No. AD110070

(264)
AFCRC-TR-57-54 June 1957

Newman, Edwin B.; Miller, George A. (Harvard University)

INFORMATIONAL EVALUATION OF LANGUAGE TRANSLATIONS

This report describes some psychological methods for evaluating the outputs of mechanical translating devices. Typically these methods provide a measure of the agreement between a machine-translation of some sample passage, on the one hand, and either the original passage or a high-quality "standard" translation of that passage, on the other. In two of the methods, human subjects are used to make this comparison. The general conclusion to be drawn from these studies is that the linguistic and mechanical aspects of the problem are in greater need of development than the more purely psychological aspect. There is an acute need to bridge the gap between the formal demonstration that machine translation is logically possible and the realization of some scheme sufficiently detailed to produce useful samples of text. Pending that development, psychological studies are more usefully directed at questions arising in a psychological context.

Project & Task: 7682-76825 Contract No. AF33(038)-14343
ASTIA No. AD110077

(265)
AFCRC-TR-57-55 September 1957

Dunlap and Associates Incorporated

FINAL REPORT ON SERVICES PERFORMED IN CONNECTION WITH TESTS OF THE T SQ/13 RADAR REPORTING SYSTEM

This is a study of the operational performance of the TSQ/13 radar reporting system (CARTRAC). This system was compared with the standard system (here called the manual system) presently in use for aircraft control. The contractor provided assistance in the collection processing and analysis of data after the experimental designs and operating procedures were well established. This is a final report of only those services performed by Dunlap and Associates in connection with test of the TSQ/13. No findings of any of the tests are published in this report.

Project & Task: 7680-76809 Contract No. AF19(604)-1372
ASTIA No. AD110082

(266)
AFCRC-TR-57-57 February 1958

Tanner, Wilson P. Jr.; Birdsall, Theodore G. (University of Michigan)

DEFINITIONS OF d' and η AS PSYCHOPHYSICAL MEASURES

Since studies employing d' and η are based on the theory of signal detectability, the theory is reviewed in sufficient detail for the purposes of definition. The efficiency, η, is defined as the ratio of the energy required by an ideal receiver to the energy required by a receiver under study when the performance of the two is the same. The measure d' is that value of $(2E/N_o)^{1/2}$ necessary for the ideal receiver to match the performance of the receiver under study, where E is the energy of the signal, and N_o is the noise power per unit bandwidth. The measure is extended to include the recognizability of two signals. Every set of signals is described by an Euclidean space in which distances are the square roots of the energy of the difference signal, $(E_\Delta)^{1/2}$. The unit of measure is the square root of one-half of the noise power per unit bandwidth $(N_o/2)^{1/2}$.

Project & Task: 7682-76822 Contract No. AF19(604)-2277
ASTIA No. AD146758

(267)
AFCRC-TR-57-58 January 1958

Green, David M.; Birdsall, Theodore G. (University of Michigan)

THE EFFECT OF VOCABULARY SIZE ON ARTICULATION SCORE

A statistical decision model is applied to the recognition of voice signals in noise. Certain strong simplifying assumptions are made to make the mathematics of the model manageable. The model is compared with the data of Miller, et al. The main problem dealt with is how the size of the vocabulary affects the articulation score. A discussion is included of the physical parameters involved in such tests. An appendix presents various approximations to the problem involved in predicting the percent correct recognition for the conditions considered by the model.

Project & Task: 7682-76822 Contract No. AF19(604)-2277
ASTIA No. AD146759

(268)
AFCRC-TR-57-59 July 1958

Corbin, Horace H.; Carter, Jaqueline A.; Reese, Ellen P.; Volkman, John (Mount Holyoke College)

EXPERIMENTS ON VISUAL SEARCH 1956-1957

The report summarizes research on two search tasks: I. The discrimination of groups of objects (targets) in searching cluttered visual displays. The research emphasized the use of visual aids to increase the efficiency of the discrimination of groups. II. The speed and accuracy of search and discrimination of near-threshold and above threshold visual targets on a horizontal array.

Project & Task: 7682-76824 Contract No. AF19(604)-1713
ASTIA No. AD240295

(269)
AFCRC-TR-58-1 July 1958

Pollack, Irwin; Rubenstein, Herbert; Decker, Louis R. (Operational Applications Laboratory)

INTELLIGIBILITY OF KNOWN AND UNKNOWN MESSAGE SETS (J. Acoust. Soc. Am., Vol. 31, No. 3, 273-279, Mar 1959)

The effect of the frequency of occurrence of words upon their intelligibility in noise was examined under two conditions: (1) in unknown message sets where the specific words under test were initially unknown to the listener; and (2) in known message sets where the specific words under test were known to the listener. Substantial effects of word frequency are observed with unknown message sets, but not with known message sets. In known message sets, the prime factor determining intelligibility is the phonemic interconfusability among the words. In unknown message sets, it is suggested that the important determinant of the intelligibility of a word is its frequency of occurrence relative to the frequencies of the words with which it might be confused.

Project: 7682
ASTIA No. AD152651

(270)
AFCRC-TR-58-2 April 1958

Pollack, Irwin; Johnson, Lawrence B.; Knaff, P. Robert (Operational Applications Laboratory)

RUNNING MEMORY SPAN (J. Exp. Psychol., Vol. 57, No. 3, 137-146, Mar 1959)

The present series of experiments compared the recall of messages composed of randomly selected digits under two conditions of presentation: (a) uncertain length, in which Ss were uncertain of the length of the to-be-presented message; and (b) certain length, in which Ss were informed of the length of the to-be-presented message. A pilot study revealed digit spans for uncertain-length messages which were considerably smaller than would be expected with certain-length messages. Further studies examined the effects on the recall of uncertain-and certain-length messages of a wide range of experimental variables.

Project: 7682
ASTIA No. AD152563

(271)
AFCRC-TR-58-3 1958

Pickett, J. M. (Operational Applications Laboratory)

PERCEPTION OF COMPOUND CONSONANTS (Language and Speech, Vol. 1, Part 4, 288-304, Oct-Dec 1958)

The perceptual confusions among English compounds of two consonants were examined. One defined class of syllables, made up of 15 initial compound consonants in conjunction with three vowel sounds /i/, /a/, and /o/, and another class of 15 final compound consonants in conjunction with the same three vowel sounds, were employed. Recorded syllables were played back against a white noise background and against a low-frequency noise background. Confusion patterns among the compound consonants depended upon the articulatory dimensions of the individual consonant members which formed the compound. That is to say, there was little evidence of interaction among the members of the compound. The confusion patterns indicated that the low speech frequencies, i. e., those frequencies heard above the white noise, convey the consonant distinctions of nasal vs. glide vs. stop, and the distinctions among glides. On the other hand, the higher speech frequencies, heard above the low-frequency noise, conveyed the distinction of affrication and the place distinctions among nasals and stops. The different vowels had minor effects on the perception of the consonants adjacent to them.

Project: 7681
ASTIA No. AD160710

(272)
AFCRC-TR-58-50 January 1958

Chomsky, Noam (Massachusetts Institute of Technology) Miller, George A. (Harvard University)

FINITE STATE LANGUAGES (Information & Control, Vol. 1, No. 2, 91-112, May 1958)

A finite state language is a finite or infinite set of strings (sentences) of symbols (words) generated by a finite set of rules (the grammar), where each rule specifies the state of the system in which it can be applied, the symbol which is generated, and the state of the system after the rule is applied. A number of equivalent descriptions of finite state languages are explored. A simple structural characterization theorem for finite state languages is established, based on the cyclical structure of the grammar. It is shown that the complement of any finite state language formed on a given vocabulary of symbols is also a finite state language, and that the union of any two finite state languages formed on a given vocabulary is a finite state language; i. e., the set of all finite state languages that can be formed on a given vocabulary is a Boolean algebra. Procedures for calculating the number of grammatical strings of any given length are also described.

Project & Task: 7682-76825 Contract No. AF33(038)-14343
ASTIA No. AD146781

(273)
AFCRC-TR-58-51 April 1958

Green, David M. (University of Michigan)

DETECTION OF COMPLEX AUDITORY SIGNALS IN NOISE, AND THE CRITICAL BAND CONCEPT

In the last two decades, considerable information has become available concerning the mechanism of auditory frequency analysis as it is inferred from behavioral data. In the first section of this thesis a review of many of these papers is presented. These include experiments from the area of masking, frequency discrimination, and loudness. All of the studies are analyzed in terms of the critical band concept proposed by Fletcher. While many of the results are consistent with the deductions obtained from this simple concept, certain relationships still remain obscure. For example, the estimates of critical bandwidth obtained from masking data differ by as much as an order of magnitude from the estimates obtained from frequency discrimination data. Two experiments concerning the detection of complex auditory signals in noise are presented. The first experiment employed as a complex signal two sinusoidal stimuli. Both the duration and the frequency separation of the signal serve as variable parameters in the experiment. It is concluded that the complex signal is more detectable than either of the two stimuli which comprise the complex. A mathematical model, which is a simple extension of the critical band concept, is presented. The model is based on the assumption that the outputs of several critical bands may be combined in detecting these stimuli. Two other models, which do not predict the data as well as the first model, are compared with the experimental data. The second experiment employed bandlimited white Gaussian noise as the signal to be detected. A statistical model which incorporates the extension of the critical band concept as it was used in the first experiment is presented. This new model provides excellent predictions for the results obtained in the second experiment. Both bandwidth and signal duration of these noise signals may be accounted for by this statistical model. The basic equation for this model is:

$$d'_{opt} = \sqrt{W\ T}\ \ \frac{S_o}{N_o}$$

where d'_{opt} is a measure of the detectability of the signal, W is the bandwidth of the noise signal, T is the signal duration, and S_o/N_o is the signal power to noise power ratio in a one cps band. As a result of this experimental work, a general model of the receiving mechanism is proposed stating that the ear may be likened to a series of bandpass filters. The output of these filters may be linearly combined, with weighting constants, so that an effectively larger bandpass can be obtained. This adjustable bandpass model is contrasted with the fixed critical band concept which Fletcher suggested.

Project & Task: 7682-76822 Contract No. AF19(604)-2277
ASTIA No. AD152566

(274)
AFCRC-TR-58-52 September 1958

Moser, Henry M. (Ohio State University)

STUDY OF RADIOTELEPHONE VOICE PROCEDURES AND RELATED RESEARCH

Final report of contract number AF19(604)-1577. Lists statement of progress during contract period, abstracts of reports under the contract and projected plans and future research indicated by military interests.

Project & Task: 7684-76841 Contract No. AF19(604)-1577
ASTIA No. AD160711

(275)
AFCRC-TR-58-53 October 1957

Licklider, J. C. R. (Massachusetts Institute of Technology)

STUDIES IN AURAL PRESENTATION OF INFORMATION

This report summarizes the results of research conducted under Air Force Contract Number AF18(600)-1219. The topics investigated were the following: (1) pitch perception, (2) auditory signal detection, (3) auditory signal identification, (4) the masking of speech by certain special types of interference, and (5) the development of a combined aural-visual radar simulator. In the section on pitch perception, the results of several experiments are described. These experiments concern the "residue effect" and the "Huggins phenomenon" and other evidences that perceived pitch is not always dependent, as the Helmholtz theory supposes, upon concentration of energy in the stimulus power spectrum. Other experiments concern effects of the phase pattern of the components of a complex tone upon its subjective pitch. Still further observations deal with the pitch of trains of pulses of regular spacing in time but random polarity. Such trains of pulses give rise to an experience in which two different kinds of pitch may be discerned. The results of the several experiments are subsumed in a "triplex theory" of auditory frequency analysis. In the section on signal detection, the results of experiments on several questions are reported. These questions concern the ways in which the detectability of a sinusoidal signal depends upon its duration and its frequency and the way in which the detectability of a complex signal depends upon the distribution of signal energy over frequency. The results of these experiments are accounted for by a model, proposed by D. M. Green, that is based upon the statistical theory of signal detectability. In the section on signal identification, we have tried to summarize the observations and tentative conclusions we have been able to make in a field that is very difficult to study systematically and inclusively in the laboratory. These observations concern primarily the discriminability and identifiability of the sounds heard through pulsed-doppler radars aimed at aircraft targets. In the section on the masking of speech, the results of two series of experiments are described. These experiments deal with the intelligibility of speech heard in the presence of (1) line-spectrum interference and (2) tonal interference that has been modulated by a narrow-band modulating signal. In addition, an arrangement for measuring or monitoring the speech-to-noise ratio during intelligibility tests is described in some detail. The final section gives a very brief description of a device for demonstrating the combined aural and visual display of certain types of radar information. This device was completed only in component form before being transferred to another Air Force project under which it has been developed further. Accordingly, only descriptions of the components are given.

Project & Task: 7681-76816 Contract No. AF18(600)-1219
ASTIA No. AD152564

(276)
AFCRC-TR-58-54 September 1959

Clarke, Frank R. (Indiana University)

CONFIDENCE RATINGS, SECOND-CHOICE RESPONSES, AND CONFUSION MATRICES IN INTELLIGIBILITY TESTS (J. Acoust. Soc. Am., Vol. 32, No. 1, 35-46, Jan 1960)

The studies reported in this paper have dealt with the responses of human observers to speech stimuli transmitted in a background of white Gaussian noise. In all cases the listeners attempted to identify the transmitted items and then made a second response in an attempt to convey additional information. It was found that when the listeners were allowed a second-choice identification response, very little information was contained in these responses which was not already contained in the listeners' first-identification response. When the second response was a confidence rating, a significant amount of information was added to that which was carried by the identification response. The rating which followed each identification response was assigned by the observers in an attempt to estimate the probability that their identification response was, in fact, correct. For message sets of four items and for sets of sixteen items, it was found that the observers were quite capable of making such estimates over a wide range of speech-to-noise ratios. Their estimates did appear to be affected to some extent by the size of the message set and by the speech-to-noise ratio, but this interaction was slight. The observers' rating responses were used to generate ROC curves. These curves were adequately fit by straight lines when the data were plotted on normal-normal probability paper. Regardless of the size of the message set, all curves, for all speech-to-noise ratios, were fit by a single slope. However, the point at which these curves intersected the abscissa was a function of both variables. Data from one set of observers in the rating experiments were used in an attempt to predict the performance of a different group of observers whose task was to monitor subsets of messages. While predictions were fairly good, discrepancies were noted. An internal check in the monitoring experiment strongly suggests that these discrepancies arose because of differences between the two groups of observers.

Project & Task: 7684-76841 Contract No. AF19(604)-1962
ASTIA No. AD247769

(277)
AFCRC-TR-58-55 July 1958

Moser, Henry M.; O'Neill, John J.; Adler, Sol (Ohio State University)

NUMBER-TELLING METHODS

Methods of telling one-, two-, three-, and four-digit numbers were tested with American and foreign speakers, and American listeners. Speakers were equally distributed among male and female representatives of the major American dialects, and foreign nationals of English, French and Spanish origin. When Americans transmitted to Americans during adverse listening conditions, the following single digit pronunciations were statistically superior: (0) ze-ro, (1) uh-wun, (3) th-r-ee, (6) six, sixer, suh-six, and (7) sev-ven. Those pronunciations which showed no differences were (2) too, tuh-hoo, tuh-too, (4) four, fo-wer, fuh-four, (5) fi-i-iv, five, fi-yiv, fife, fuh-five, fiver, (8) ait, a-ait, aiter, and (9) nine, ni-yen, nyner, and nuh-nine. When foreign speakers transmitted to Americans during adverse listening conditions the following single digit pronunciations were statistically superior: (0) ze-ro, zero, (2) too, tuh-too, (4) four, (5) fi-i-iv, five, (6) six, sixer, (8) ait, a-ait. All other pronunciations showed no differences. When transmitting two-, three-, or four-digit numbers, all speakers were more intelligible with the single-digit telling method. This method was statistically superior for every phase of the study with the exception of two-digit number telling in the American-American communication net.

Project & Task: 7681-76813 Contract No. AF19(604)-1577
ASTIA No. AD152647

(278)
AFCRC-TR-58-56 August 1958

Moser, Henry M.; O'Neill, John J.; Oyer, Herbert J.; Wolfe, Susan M.; Abernathy, Edward A.; Schowe, Ben M., Jr. (Ohio State University)

HAND SIGNALS: FINGER-SPELLING

This study examines the possibilities of using the finger-spelling alphabet of the deaf as a supplementary medium of communication in high level noise and/or other situations where voice communications are not desirable or effective. Subjects were 24 deaf students. At 125 feet, the greatest distance tested with the entire group, the average intelligibility was 87.6%. In general, the intelligibility of alphabet letters was high enough at such distances as 175 feet to indicate possibilities of using the finger-spelling alphabet as a means of supplementing or clarifying present hand signals now in use.

Project & Task: 7681-76813 Contract No. AF19(604)-1577
ASTIA No. AD152648

(279)
AFCRC-TR-58-57 August 1958

Moser, Henry M.; O'Neill, John J.; Wolfe, Susan M. (Ohio State University)

TESTS OF THE AURAL COMPREHENSION OF ENGLISH BY FOREIGN STUDENTS

Parts of two tests of Aural Comprehension of English, the Lado Test of Aural Comprehension Form C and the MDAP English Proficiency Exam Form B were administered to forty-four foreign students of 25 nationalities. Significant relationship was found between the scores of the two tests. The MDAP test deals more extensively with military vocabulary than does the Lado but they are both capable of evaluating the aural comprehension of foreign nationals. The Lado test is less time consuming and probably to be preferred when technical language evaluation is not important.

Project & Task: 7681-76813 Contract No. AF19(604)-1577
ASTIA No. AD152649

(280)
AFCRC-TR-59-2 April 1959

Pollack, Irwin (Operational Applications Laboratory)

MESSAGE REPETITION AND MESSAGE RECEPTION (J. Acoust. Soc. Am., Vol. 31, No. 11, 1509-1515, Nov 1959)

The improvement in word intelligibility associated with successive presentations of a word in noise was examined with recorded and with independent samples of the speech and/or its background noise. The listener's criterion for termination of a trial was shown to be a crucial determinant of the gain of intelligibility with successive presentations. The improvement in intelligibility was greater for independent samples of speech and noise than for successive presentations of a single recorded sample. The observed improvement, however, was less than predicted for the ideal observer with perfect memory by the theory of signal detectability. Indexex of response discriminability and signal discriminability are briefly discussed.

Project & Task: 7682-76821
ASTIA No. AD212079

(281)
AFCRC-TR-59-3 July 1959

Pickett, J. M. (Operational Applications Laboratory)

BACKWARD MASKING (J. Acoust. Soc. Am., Vol. 31, No. 12, 1613-1615, Dec 1959)

An experiment was carried out to explore the auditory masking effect of a noise burst on a preceding weak stimulus. A short 1000-cycle tone preceded a burst of white noise by a variable silent interval. The threshold intensity level of the tone was taken as a measure of the masking provided by the noise burst. The effects were examined of combinations of the following conditions: tone durations of 5, 10, 15, 20, 25 and 50 msec; silent intervals of 0, 2, 5, 10, 25 and 100 msec; and noise burst levels ranging from 50 to 130 db SPL. Appreciable elevations of tone threshold were observed for silent intervals less than 25 msec. Threshold elevations increased progressively as noise burst level was increased. The latter effect increased with shorter silent intervals. The tone-noise interval was a more critical factor than a tone duration.

Project: 7681
ASTIA No. AD233899

(282)
AFCRC-TR-59-6 May 1959

Pollack, Irwin; Trittipoe, W. J. (Operational Applications Laboratory)

BINAURAL LISTENING AND INTERAURAL NOISE CROSS CORRELATION (J. Acoust. Soc. Am., Vol. 31, No. 9, 1250-1252, Sep 1959)

The identification of different interaural correlations was examined over a range of reference correlations. Interaural correlations were produced by the method of Licklider and Dzendolet in which three independent noise sources were combined into two outputs. The change in interaural correlation (squared) required for 75 percent correct identification varied from about 0.4 for a reference correlation of 0.0 to about 0.04 for a reference correlation of 1.0.

Project & Task: 7681-76813
ASTIA No. AD216179

(283)
AFCRC-TR-59-7 May 1959

Pickett, J. M. (Operational Applications Laboratory)

LOW-FREQUENCY NOISE AND METHODS FOR CALCULATING SPEECH INTELLIGIBILITY (J. Acoust. Soc. Am., Vol. 31, No. 9, 1259-1263, Sep 1959)

Speech intelligibility was tested in a low-frequency masking noise. Various conditions of speech and noise filtering below 1200 cps were employed in order to test the relative effects of direct low-frequency masking and upward spread of masking to higher frequency regions. Tests were carried out at three noise spectrum levels which corresponded to overall unfiltered levels of 85, 105, and 115 db. The results showed significant decreases in intelligibility as the noise energy was admitted progressively between 300 and 20 cps. Further, the speech frequencies between 20 and 300 cps provided no significant contribution to intelligibility under any noise condition tested. It is, therefore, concluded that the low frequency energy in the noise produced upward spread of masking. This interpretation is reinforced by the fact that spread of masking was greater at higher noise levels and also at lower speech-to-noise ratios. Implications for calculating the effects of noise interference upon intelligibility are discussed.

Project & Task: 7684-76841
ASTIA No. AD233900

(284)
AFCRC-TR-59-10 May 1959

Rubenstein, Herbert (Operational Applications Laboratory); Aborn, Murray (National Institutes of Health

PSYCHOLINGUISTICS (Ann. Rev. Psychol., Vol. 11, 291-322, 1960)

This is a survey of psycholinguistic literature from 1954 through 1958. All relevant American journals and in addition whichever British, Canadian, French and Russian journals which were available to the authors, are covered. Only the most germane works in the field of psycholinguistics are included.

Project & Task: 7682-76821
ASTIA No. AD237526

(285)
AFCRC-TR-59-13 March 1960

Pollack, Irwin (Operational Applications Laboratory)

TEMPORAL SAMPLING PARAMETERS OF INTERAURAL NOISE CORRELATIONS (J. Acoust. Soc. Am., Vol. 32, No. 7, 795-799, Jul 1960)

The minimal interaural noise correlation discriminable by trained listeners was examined as a function of temporal sampling parameters of the noise. The prime determinant of the listeners' performance is the total integrated duration of the noise samples, irrespective of the other temporal parameters. Within the restriction of a constant integrated duration, superior performance is attained with an interval of about 2 msec between successive brief noise samples.

Project & Task: 7681-76812

(286)
AFCRC-TR-59-14 June 1959

Pollack, Irwin (Operational Applications Laboratory)

IDENTIFICATION OF VISUAL CORRELATIONAL SCATTERPLOTS (J. Exp. Psychol., Vol. 59, No. 6, 351-360, 1960)

Visual correlation scattergrams were obtained by mixing a common noise source, C, with independent noise sources, A and B, and displaying the mixtures (C+A) and (C+ B) across the x and y coordinates of an oscilloscope. The correlational distributions were displayed upon the oscilloscope either (a) by a continuous beam of electrons or (b) by sampling the beam to obtain discrete samplings of the display. The task of S was to identify whether the reference correlation or a higher correlation was presented. The variables examined were the duration, size, and sampling characteristics of the display and the upper cutoff frequency of the noise distributions. In terms of the magnitude of the difference between the reference and variable correlations required for 75% correct identification: (a) Sensitivity is greatest for the highest reference correlations. (b) Sensitivity decreases with narrower bandwidths and shorter display times, with rapid changes below burst durations of 100 msec. (c) Sensitivity for the sampled discrete pulsed display is determined by the number of sampling pulses, and is independent of the pulsing rate and duration of the display, except insofar as they determine the number of sampling pulses. The results are interpreted in terms of the task of S as a tester of alternative statistical hypotheses under conditions of varying reliability of the display information.

Project & Task: 7682-76823
ASTIA No. AD239459

(287)
AFCRC-TR-59-16 November 1959

Kershner, Alan M. (Operational Applications Laboratory)

THE EVALUATION OF AIR FORCE WEATHER FORECASTERS

This report describes an AF Weather Forecaster Research Program in which forty-eight weather forecaster performance characteristics and abilities were identified and two evaluation instruments each capable of completion in ten minutes or less, were developed to tap these characteristics. Additional information pertaining to supervisor-subordinate relationships and time necessary for evaluation is presented. The need for such instruments and their uses is discussed. Also described is a large-scale employment of the nominating technique for securing criterion data.

Project & Task: 9671-96717
ASTIA No. AD236084

(288)
AFCRC-TR-59-17 December 1959

Kershner, Alan M.(Operational Applications Laboratory); Jenner, William A. (Air Weather Service)

BIOGRAPHICAL CHARACTERISTICS OF AIR FORCE WEATHER FORECASTERS

Biographical characteristics which distinguish between good and poor AF weather forecasters, as rated by colleagues, are presented for items pertaining to age, formal school and training, and on-the-job experience for 300 officers, and for 129 warrant and enlisted forecasters.

Project & Task: 9671-96717

(289)
AFCRC-TR-59-51 1959

Krendel, Ezra S.; Wodinsky, Jerome (Franklin Institute)

VISUAL SEARCH IN AN UNSTRUCTURED VISUAL FIELD

Binocular visual search in an unstructured field has been studied. The adequacy of an exponential distribution function to describe the detection probabilities in visual search has been demonstrated. Cumulative distribution functions for visual search have been measured for the following parameters: background luminance, size of search field, target size and contrast. In the major experiment, 3072 trials for each of four practiced observers supplied the basic data for this report.

Project & Task: 7682-76824 Contract No. AF19(604)-1513
ASTIA No. AD211156

(290)
AFCRC-TR-59-54 April 1960

Tanner, Wilson P. Jr.; Birdsall, Theodore G.; Clarke, Frank R. (University of Michigan)

THE CONCEPT OF THE IDEAL OBSERVER IN PSYCHOPHYSICS

This report discusses the manner in which the concept of the ideal observer serves as a tool for the development of a description model of human performance in the detection and recognition of signals.

Project & Task: 7682-76822 Contract No. AF19(604)-2277
ASTIA No. AD239022

(291)
AFCRC-TR-59-55 October 1959

Elliott, P. B. (University of Michigan)

TABLES OF d'

Tables of d' for yes-no and forced-choice experiments are presented along with explanations of the assumptions involved in the calculations.

Project & Task: 7682-76822 Contract No. AF19(604)-2277
ASTIA No. AD239023

(292)
AFCRC-TR-59-56 November 1959

Systems Development Corporation

FINAL REPORT: CONTRACT NO. AF19(604)-2635

This report describes work done during period 1 April 1958 and 30 November 1959 on contract entitled "Study of Analysing Operator tasks in Relation to the Experimental SAGE Sector Computer Programs and Equipment". Report reviews the general apprach of the work, describes each of the areas of work and provides a bibliography of the documents produced for the contract.

Project & Task: 1975-76891 Contract No. AF19(604)-2635
ASTIA No. AD230033

(293)
AFCRC-TR-59-57 December 1959

Walker, Peyton G.; Pool, Ernest T.; Parker, James F., Jr.; Kelly, Paul J.; Walker, Walter T. III; Smith, Paul E. (Psychological Research Associates, Incorporated)

HUMAN FACTORS SUPPORT PROGRAM FOR OPERATOR PERSONNEL AN/TSQ-13 DATA PROCESSING SUBSYSTEM (SYSTEM 412L)

Training manuals corresponding to the principal operator positions of the TSQ-3 Subsystem were produced. These manuals were designed for training operator personnel who were previously trained for a manual tactical air control system. The manuals contained information on the operation of the equipment associated with each position and on the operational procedures of the position with respect to other positions in the site and system. A training program of approximately three months duration was provided by the contractor at the TSQ-13 test sites for the training of operator personnel. Performance measures for the evaluation of operator proficiency were designed and administered during the terminal phases of the training program.

Project & Task: 7684-76876 Contract No. AF19(604)-5194
ASTIA No. AD230270

(294)
AFCRC-TR-59-58 December 1959

Egan, James P.; Greenberg, Gordon Z.; Schulman, Arthur I. (Indiana University)

OPERATING CHARACTERISTICS, SIGNAL DETECTABILITY, AND METHOD OF FREE RESPONSE (J. Acoust. Soc. Am., Vol. 33, No. 8, 993-1007, Aug 1961)

The method of free response refers to the following listening situation. Against a background of noise, a weak signal is presented several times in a long (2-min) observation interval. The temporal intervals between the presentations of the tones are randomly distributed; consequently, the listener does not know when a tone will occur, and he does not know how many tones will be presented. From one series of observation intervals to the next, the listener is instructed to adopt various criteria and to press the single response-key each time he "hears a tone". The problem consists in the determination of a procedure that allows the total number of yes responses to be partitioned meaningfully between "hits" and "false alarms". A model is developed in which the measurable quantity, rate of response, is related to the "hit rate" and to the "false-alarm rate". Although the criterion adopted by the listener cannot be directly evaluated, the use of a wide range of criteria makes it possible to estimate the detectability d_s of the signal. Two experiments are described, and the results support the model.

Project & Task: 7684-76841 Contract No. AF19(604)-1962
ASTIA No. AD251006

(295)
AFCRC-TR-59-59 January 1960

Creelman, C. Douglas (University of Michigan)

DETECTION OF COMPLEX SIGNALS AS A FUNCTION OF SIGNAL BANDWIDTH AND DURATION

An experimental examination of the efficiency of human observers in detecting a stimulus waveform which consists of a train of damped sinusoids is reported. The signal duration and degree of damping (or spectral bandwidth) were varied, with the energy of the signal held constant. Bandwidth is shown to affect human detection more at long than at short durations.

Project & Task: 7682-76822 Contract No. AF19(604)-2277
ASTIA No. AD239024

(296)
AFCCDD-TR-60-20 June 1960

Green, David M. (Massachusetts Institute of Technology)

PSYCHOACOUSTICS AND DETECTION THEORY (J. Acoust. Soc. Am., Vol. 32, No. 10, 1189-1203, Oct 1960)

This paper presents a fairly complete review of detection theory as it is applied to certain psychoacoustic data. Detection theory is treated as a combination of two theoretical structures: decision theory and the concept of ideal observer. The paper discusses how statistical decision theory has been used to analyze the auditory threshold process. By treating the threshold process as an instance of hypothesis testing, two determinants of the process are recognized: (1) the detectability of the signal and (2) the criterion level of the observer. The theory provides a technique of analysis which allows one to obtain a quantitative estimate of both factors. The measure of signal detectability appears to be independent of the psychophysical procedure when the physical parameters of signal and noise are held constant. The concept of ideal observer is reviewed with special emphasis on the assumptions of the derivation. The usefulness of this concept is illustrated by considering the shape of the pychophysical function-the function relating the detectability of the signal to its intensity. A rather general model based on the concept of signal uncertainty is presented which attempts to explain this relationship.

Project & Task: 7682-76822 Contract No. AF19(604)-1728
ASTIA No. AD247496

AFCRC-TR 59-69
Shultz, G.L.
Inves. Procedures for Speech Recognition
(Appears in Proc. of Seminar on Speech Compression
& Processing. AFCRC-TR 59-198, Vol 2)

(297)
AFCCDD-TR-60-21 1961

Swets, John A.; Green, David M. (Massachusetts Institute of Technology)

SEQUENTIAL OBSERVATIONS BY HUMAN OBSERVERS OF SIGNALS IN NOISE (Information Theory, Fourth London Symposium)

In this paper the results of a preliminary investigation of the trading relationship between time and error in a very simple signal detection task are reported. The observer must decide whether or not a signal exists in a background of noise---he is allowed to make as many observations as he chooses before making his decision. Three experiments are reported. Results are examined to determine whether error rates and mean number of observations vary appropriately as the pay-off values are changed. The efficiency of sequential tests are compared to tests of fixed length. It is then determined whether or not observers combine the information in successive observations. Findings are as follows: The error rates and the mean numbers of observations vary with each other and, in addition, vary with the pay-off values, in accordance with the model described in the report. The three experiments are consistent on this point, showing rank-order correlations that are consistently near unity. Thus, on a general level, the sequential model provides a good description of human observers. A further prediction, that sequential tests are more efficient than fixed-length tests, is also supported. The evidence also indicates that human observers are indeed capable of integrating the information in successive observations.

Project & Task: 7682-76822 Contract No. AF19(604)-1728

(298)
AFCCDD-TR-60-25 June 1960

Chenzoff, Andrew P.; Flores, Ivan; Crittenden, Richard L.; Frances, Albert S.; Mackworth, Norman H.; Tolcott, Martin A. (Dunlap and Associates, Incorporated)

HUMAN DECISION MAKING AS RELATED TO AIR SURVEILLANCE SYSTEMS: Technical Report No. I, A Survey of Literature and Current Research

This report is the first of a series of studies conducted under contract AF19(604)-6164. It presents a review of the literature on decision making. The objectives of this survey were: (1) To describe some of the decision making information now available in the areas of mathematics, experimental psychology, sociology and systems research. (2) To identify areas for further experimentation on human decision making. For many years to come human decision making will remain of great practical importance for many kinds of decisions even in those situations where machines are being used to the fullest extent. These experiments will therefore consider as far as possible those aspects of decision making that humans must undertake in air surveillance.

Project & Task: 4690-46902 Contract No. AF19(604)-6164
ASTIA No. AD238339

(299)
AFCCDD-TR-60-26 April 1960

Pollack, Irwin (Operational Applications Laboratory)

HEARING (Ann. Rev. Psychol., Vol. 12, 335-362, 1961)

This is a review of the literature in the field of Hearing. The review is topically organized under the following main headings: Monographs, Bekesy's Skin Model of the Cochlea, Physiology of the Auditory System, Comparative Study of Audition, Theory of Signal Detectability, Loudness and Loudness Scaling, Pitch, Masking, Binaural Listening, Noise Induced Hearing Loss, Audiometry, Response to Low Frequencies, and Speech. A bibliography of the 204 sources cited is included at the end of the review.

Project: 7682
ASTIA No. AD259885

(300)
AFCCDD-TR -60-27 August 1960

Kryter, Karl D. (Bolt, Beranek & Newman, Incorporated)

HUMAN ENGINEERING PRINCIPLES FOR THE DESIGN OF SPEECH COMMUNICATION SYSTEMS

A model of the behavior of the auditory system in response to speech signals was developed at the Bell Telephone Laboratories. The model says (assuming a given talker-listener proficiency and a given message-set size) that the intelligibility of a speech signal is proportional to the signal-to-noise ratio averaged over 20 specified bands of frequencies. The score resulting from the application of this formula to the speech signal and the noise present in a communication system is called the Articulation Index or AI. Report discusses how model (A1) may perhaps be modified to take into consideration extreme conditions not uncommon in military communications of noise and distortion stresses under which the model formerly broke down. The conditions of masking effects, peak clipping and varying levels of vocal effort are discussed, the model modified, and work sheets and graphs are presented that make the calculation of an Articulation Index for a given system a "cookbook" operation.

Project & Task: 7684-76842 Contract No. AF19(604)-4061
ASTIA No. AD243414

(301)
AFCCDD-TR -60-32 February 1961

Egan, James P.; Greenberg, Gordon Z.; Schulman, Arthur I. (Indiana University)

INTERVAL OF TIME UNCERTAINTY IN AUDITORY DETECTION (J. Acoust. Soc. Am., Vol. 33, No. 6, 771-778, Jun 1961)

Three experiments were conducted to measure the decrement in performance that results from uncertainty in the time of onset of a signal presented against a continuous background of noise. The fixed-interval observation experiment was employed. A light defined an observation interval for the listener during which the signal, a tone of 1000 cps, either was or was not presented [$p(SN) = 0.5$]. The signal, when presented, started at an instant randomly selected within the observation interval. Thus, the listener was uncertain as to (1) whether or not the signal would occur in the observation interval, and (2) the onset time of the signal, if in fact the signal occurred. The interval of time uncertainty (ITU) during which the tone might start was systematically varied from one series of trials to the next, and the listener knew the duration of ITU in each series. After each observation interval, the listener indicated his confidence that a tone was presented by using a rating scale. Operating characteristics [$p(y/SN)$ against $p(y/N)$] were plotted on normal-normal coordinates, and measures of detectability were computed. The functional relation between the detectability index d_s and the interval of time uncertainty is presented for each experiment.

Project & Task: 7684-76841 Contract No. AF19(604)-1962

(302)
AFCCDD-TR -60-33 September 1960

Moser, Henry M. (Ohio State University)

RESEARCH AND RELATED OPERATIONAL SERVICES FOR SIMPLIFIED INTERNATIONAL AERONAUTICAL LANGUAGE

This report describes progress on research during contract period 1 October 1958 - 31 March 1960. Abstracts of technical notes published, and personnel appointed on the contract are listed.

Project & Task: 7686-76861 Contract No. AF19(604)-4575
ASTIA No. AD247155

(303)
AFCCDD-TR -60-34 October 1960

Brown, Charles R.; Rubenstein, Herbert (Operational Applications Laboratory)

TEST OF RESPONSE BIAS, EXPLANATION OF WORD-FREQUENCY EFFECT (Science, Vol. 133, No. 3448, 280-281, Jan 1961)

Observers identified monosyllabic words presented in noise. It was found that controlling response bias eliminates the word-frequency effect. However, the magnitude of the word-frequency effect was greater than that predicted by a mathematical model denying stimulus words any role in producing the word-frequency effect.

Project: 7684
ASTIA No. AD255889 and AD259889

(304)
AFCCDD-TR-60-37 February 1960

Goldiamond, Israel (Southern Illinois University)

BLOCKED SPEECH COMMUNICATION AND DELAYED FEED-BACK: AN EXPERIMENTAL ANALYSIS: (Technical Report No. 1, and Progress Report)

This report concerns the experimental analysis of blocked verbal communication (stuttering). It is composed of two parts: (1) A rationale for such analysis and (2) A progress report of research performed, using such analysis for the period 1 December 1958 to 29 February 1960.

Project & Task: 7682-76821 Contract No. AF19(604)-6127
ASTIA No. AD281436

(305)
AFCCDD-TR-60-38 September 1960

Goldiamond, Israel (Southern Illinois University)

THE TEMPORAL DEVELOPMENT OF FLUENT AND BLOCKED SPEECH COMMUNICATION: Final Report and Technical Reports 2, 3, 4

Report describes research on effects of delayed feedback on fluent and non fluent (stuttering) speech communication. Subjects read novels 90 minutes a day, five days a week over a period of many months. Varying conditions of delayed feedback of the recorded voice of the subject and self monitoring of occasions of stuttering were introduced. The distribution of pause durations in speech were also studied.

Project & Task: 7682-76821 Contract No. AF19(604)-6127
ASTIA No. AD281395

(306)
AFCCDD-TR-60-39 October 1960

Creelman, C. Douglas (University of Michigan)

HUMAN DISCRIMINATION OF AUDITORY DURATION

A series of related experiments was performed which measured human ability to discriminate durations of auditory signals. A two-alternative forced-choice procedure was used: two sine-wave signals of identical amplitude and frequency, differing only in duration, were presented sequentially on each trial. The order of presentation was random, and the observers' task was to state, for each trial, whether the longer signal had occurred first or second. The signals were presented in a background of continuous white masking noise, which was held at a constant level throughout the experiments. Paid observers worked two hours daily for the course of the experiments. Sufficient data were thus available to allow separate treatment for each observer. The independent variables were the signal voltage, the "base" duration, T, and the increment duration, ΔT. Separate experiments assessed the functional effect of each of these variables on discrimination. These were used to predict the results of two further experiments. The model used in this prediction was derived from statistical decision theory. Duration measurement was assumed to be accomplished by a "counting mechanism", operating on impulses generated over the relevant duration. The source of these impulses was assumed to be random. Limitations on performance were assumed to come from uncertainty regarding the end-points of the time interval, and from limited memory. These considerations led to the formula:

$$(d')^2 = \frac{\lambda}{1+KT} \cdot \frac{\Delta T^2}{2T+\Delta T+\sigma_v^2}$$

where d' is the dependent variable, a normal transformation of probability of correct response. The constants λ and K were respectively measures of "counting rate" and memory decay with time, estimated separately for each observer, and σ_v^2 was an inverse power function of signal voltage, a measure of uncertainty regarding starting-time and ending-time of the signals. The decision processes underlying this formula were presented as a general model for discrimination of durations, and shown to agree with the data regarding auditory signals.

Project & Task: 7682-76822 Contract No. AF19(604)-2277
ASTIA No. AD247384

(307)
AFCCDD-TR-60-40 November 1960

Coules, John; Duva, James S.; Ganem, George (Operational Applications Laboratory)

EFFECT OF VISUAL NOISE ON THE JUDGMENT OF COMPLEX FORMS

Judgments of complexity of 20 irregular shapes were obtained with varying visual noise and exposure duration. The number of sides of the forms account for 86% of the rating variance. Form differences significantly affected judged complexity scores. It may not be assumed that irregular forms in a given polygon category are equivalent in terms of complexity ratings; nor can it be said that forms with the same number of sides are necessarily equal. Visual noise affects complexity ratings of irregular forms. The ratings showed that forms differentially interact with noise. Exposure duration was not an important factor for judged complexity of forms.

Project & Task: 9674-96743
ASTIA No. AD249423

(308)
AFCCDD-TR-60-41 November 1960

Nickerson, Raymond S.; Duva, James S. (Operational Applications Laboratory)

TARGET POSITION AS A CODING DIMENSION

An experiment was conducted to determine the number of discrete positions of a dot in a square which can be discriminated under a variety of conditions. The results indicate: (1) the number will be at least 64 when the viewing time is 10 seconds; (2) within broad limits this will be independent of the size of the square and the size of the dot relative to the size of the square; (3) when exposure duration is extremely brief the number of discriminable positions will be less and will vary with size of square. Estimates are given for the maximum number of discriminable dot positions for various display-size, exposure duration conditions.

Project: 9674
ASTIA No. AD249422

(309)
AFCCDD-TR-60-43 November 1960

Hodge, Milton H.; (University of Georgia), Pollack, Irwin (Operational Applications Laboratory)

CONFUSION MATRIX ANALYSIS OF SINGLE AND MULTIDIMENSIONAL AUDITORY DISPLAYS (J. Exp. Psychol. Vol. 63, No. 2, 129-142, 1962)

Eight experiments were designed to evaluate a model -- the constant-ratio rule -- of sensory organization. The model was tested by comparing the obtained probabilities of 4 X 4 and 2 X 2 confusion matrices with the probabilities predicted from 8 X 8 matrices. The auditory dimensions of frequency, intensity, and duration were used singly and in combination to form single and multi-dimensional stimulus ensembles consisting of two, four, or eight tones. Six Ss attempted to identify, one at a time, the stimulus objects of the ensembles. The results indicate: (a) In general, the CRR makes excellent predictions of the response probabilities of the single and multi-dimensional matrices. The notable exceptions occur when predictions for 2 X 2 matrices are made from adjacent objects in widely spaced ensembles. (b) The CRR predicts the probabilities for the multi-dimensional matrices somewhat better than those of the single-dimensional ensembles.

Project & Task: 9670-96705 Contract No. AF19(604)-7299
ASTIA No. AD409509

(310)
AFCCDD-TR-60-44 August 1961

Swets, John A.; Sewall, Susan T. (Massachusetts Institute of Technology)

STIMULUS VS RESPONSE UNCERTAINTY IN RECOGNITION (J. Acoust. Soc. Am., Vol. 33, No. 11, 1586-1592, Nov 1961)

We raise again, in the framework of a very simple recognition task, the question of the relative efficacy of specifying the stimulus alternatives before and after the stimulus is presented. Our experiments show information given before the observation to facilitate recognition and information given after the observation to have little, if any, effect. We conclude that the facilitative effect of restricting alternatives, in the task studied, depends on a perceptual mechanism rather than on a response mechanism. These experiments are discussed in connection with two current psychological theories: the theory of signal detectability, which is essentially a perceptual theory, and the theory of individual choice behavior, which is essentially a response theory. The results of another experiment, the only other experiment discovered to date for which these two theories make different predictions, are also reported. In this experiment, too, the results are in agreement with the detection theory.

Project & Task: 7682-76822 Contract No. AF19(604)-7459

(311)
AFCRC-TR-60-50 December 1959

Newman, Edwin B.; Miller, George A. (Harvard University)

FINAL REPORT: CONTRACT NO. AF33(038)-14343

Reports on work under this contract from 16 June 1950 to 31 January 1959. Research personnel employed during the course of the contract and a bibliography of reports are listed. A not previously published report by Dr. George Sperling entitled, "Information Available in a Brief Visual Presentation" is attached as a supplement. Research is primarily in the fields of communication, data transmission, information theory, information retention and storage, information content and redundancy of English and other languages.

Project & Task: 7682-76825 Contract No. AF33(038)-14343
ASTIA No. AD239109

(312)
AFCRC-TR-60-51 1959

Newman, Edwin B. (Harvard University)

MEN AND INFORMATION: A PSYCHOLOGIST'S VIEW (Bologna Tipografia Compositori, Nuovo Cimento, No. 2 del Supplemento al Vol. 13, Serie X, 539-559, 1959)

Article discusses information in single Perceptual displays, perceptual capacity in real time, channel capacity in motor output, memory, man as a channel. Primary concern is information theory as related to man, both his capacity and limitations for input, retention and output.

Project & Task: 7682-76825 Contract No. AF33(038)-14343
ASTIA No. AD239110

(313)
AFCCDD-TR-61-1 1961

Gundy, Richard F. (Indiana University)

AUDITORY DETECTION OF AN UNSPECIFIED SIGNAL (J. Acoust. Soc. Am., Vol. 33, No. 8, 1008-1012, Aug 1961)

Listeners were required to detect an auditory signal against a background of "white noise". The effects (1) of giving trial-by-trial information as to whether or not a signal was delivered, and (2) of giving the subject an opportunity to hear the signal before the test sequence began, were studied at two levels of signal energy. The results were analyzed within the context of the theory of signal detectability. Subjects who were given an opportunity to hear the signal before the test sequence began maintained a stable level of performance throughout the experimental session. On the other hand, subjects who were given no opportunity to hear the signal performed near chance level at the beginning of the session but showed gradual improvement as the trials progressed. The effect of trial-by-trial feedback was surprisingly small in all groups. Near the end of the session, the signal was demonstrated to all subjects and the differences between the groups vanished.

Project & Task: 7684-76841 Contract No. AF19(604)-1962

(314)
ESD-TR-61-2 May 1961

Story, Anne W. (Operational Applications Laboratory)

MAN-MACHINE SYSTEM PERFORMANCE CRITERIA

Four categories of criteria are developed for the evaluation of Man-Machine system performance. The applicability of these criteria during system design, building, and testing is discussed. Some illustrative evaluations of man-machine systems are surveyed. Problems that accrue through the use of simulative features in the assessment of system performance are considered.

Project & Task: 4690-46902
ASTIA No. AD260528

(315)
AFCCDD-TR-61-3 September 1960

Swets, John A. (Massachusetts Institute of Technology)

DETECTION THEORY AND PSYCHOPHYSICS: A REVIEW (Psychometrika, Vol. 26, No. 1, Mar 61)

The application in psychophysics of the general theory of signal detection is discussed. Theory of signal detectability (TSD) is a combination of two theoretical structures: (1) statistical decision theory and (2) the theory of ideal observers. How the decision-theory aspects and the ideal-observer concepts of TSD have been applied to human behavior, are mentioned. An extensive bibliography on the subject is included.

Project & Task: 7682-76822 Contract No. AF19(604)-7459
ASTIA No. AD256720

(316)
AFCCDD-TR-61-5 October 1960

Crook, Mason N.; Bisbop, Harold P.; Feehrer, Carl E.; Wade, Edward A. (Tufts University)

LUMINANCE REINTENSIFICATION AT FREQUENCIES FROM 40 TO 300 CYCLES PER SECOND AS A FACTOR IN THE READING OF SIMULATED VISUAL DISPLAYS

If a visual display is periodically reintensified at a frequency above a certain critical value, no flicker will be perceived with steady eye fixation, but during eye movement a series of spaced images may appear. The effect of this phenomenon on the reading of displays was investigated. Several types of display material were used, and the following conditions were varied: luminance level, luminance contrast, uniformity of luminance among display elements, color, size of characters in the display, spatial extent of display, and frequency, wave form and duty cycle of the periodic reintensification. Results from a series of experiments covering selected combinations of these variables were overwhelmingly negative with respect to any significant effect of reintensification on performance. Though the spaced images may in some cases be observable during eye movement, they disappear on fixation, and observations made in the course of the study suggest that familiarization readily minimizes any distracting effect they may have. It can be concluded that reintensification above the critical frequency of flicker creates no significant problem for the reading of visual displays.

Project & Task: 1975-76891 Contract No. AF19(604)-4949
ASTIA No. AD255556

(317)
AFCCDD-TR-61-8 March 1961

Green, David M. (Massachusetts Institute of Technology)

DETECTION OF AUDITORY SINUSOIDS OF UNCERTAIN FREQUENCY (J. Acoust. Soc. Am., Vol. 33, No. 7, 897-903, Jul 1961)

The decrease in the detectability of a gated sinusoidal signal in noise caused by deliberately introducing uncertainty about the signal's frequency is no greater than 3 db, even in an extreme condition of uncertainty. In this extreme condition the signal duration is 0.1 sec, and the signal frequency is varied between 500 and 4000 cps. This effect is not critically dependent on signal duration. Moreover, the observers not only detect the signal but display at least gross information about the frequency of the signal in the uncertain frequency conditions. Several models, suggested in previous studies, are considered. The magnitude of the decrease observed in the data falls far short of the predictions of these models. An interpretation suggested by the data is that the observers in a detection task, even when a signal of fixed frequency is used, are highly uncertain as to the exact physical parameters of the signal. Another way of stating this assumption is to say that the observer never tests for the presence or absence of a signal on tbe basis of one simple hypothesis. From this assumption we should expect little decrease in detectability from deliberately introducing frequency uncertainty. This interpretation would suggest the same result would be obtained if time were the major experimental variable.

Project & Task: 7682-76822 Contract No. AF19(604)-7459

(318)
AFCCDD-TR-61-9 December 1960

Chenzoff, Andrew P.; Crittenden, Richard M.; Kelley, Charles R.; Flores, Ivan; Frances, Albert S.; Mackworth, Norman H.; Tolcott, Martin A. (Dunlap and Associates, Incorporated)

HUMAN DECISION MAKING AS RELATED TO AIR SURVEILLANCE SYSTEMS: FINAL REPORT

This is the final report of work performed under contract AF19(604)-6164 concerned with Human Decision Making as Related to Air Surveillance Systems. This final report has several objectives: (1) To summarize and bring up to date the literature survey, and to relate gaps in the literature to a recommended program of research. (2) To describe the implications of the systems survey for the recommended program of research. (3) To describe analyst-programmer decision tasks in future systems and their research implications. (4) To describe the preliminary experimental work conducted under this contract and the directions in which it should be expanded. (5) To enumerate the topics for research that have been suggested by the work to date.

Project & Task: 4690-46902 Contract No. AF19(604)-6164
ASTIA No. AD255457

(319)
AFCCDD-TR-61-10 September 1960

Swets, John A. (Massachusetts Institute of Technology)

IS THERE A SENSORY THRESHOLD? (Science, Vol. 134, No. 3473, 168-177, Jul 1961)

This is a discussion of the concept of sensory threshold and implications for present experimental practice. Data from three experiments are considered--the yes-no, second-choice, and rating experiments--in relation to five competing theories concerning the processes underlying these data. The three sets of data are in agreement with detection theory, a theory that denies the existence of a sensory threshold. Low-threshold, high-threshold, two threshold and quantal theories are discussed. Even though there is a possibility of a threshold, since it is practically unmeasurable, it will not be a very useful concept in experimental practice. In summary, in measuring sensitivity it is desirable to manipulate the response criterion so that it lies in a range where it can be measured, to include enough catch trials to obtain a good estimate of this response criterion, and to use a method of analysis that yields independent measures of sensitivity and response criterion.

Project & Task: 7682-76822 Contract No. AF19(604)-7459
ASTIA No. AD262676

(320)
ESD-TR-61-17 April 1961

Shettel, Harris H.; Angell, David; Lumsdaine, Arthur A. (American Institute for Research)

SELF-INSTRUCTIONAL PROGRAMS FOR SAGE SYSTEM OPERATORS: FINAL REPORT

The primary aim of the work done under this contract was to develop and evaluate self-instructional techniques and materials as applied to the training of basic job knowledges and skills for command and control operator tasks, represented by the SAGE Track Monitor and Intercept Director positions. Initial efforts concentrated on the development of two source documents covering all relevant basic knowledges and skills needed for each position based upon a review of the existing literature, observations of the tasks, and extensive interviews with operational personnel. These documents were subsequently utilized as the primary source of basic job knowledge for the two self-instructional programs. The results obtained in the application of these programs and devices support the feasibility of training complex tasks found in SAGE and other L-systems by means of self-instructional techniques. Also supported by this work is the use of a variety of programming techniques in a single large scale program. Reccmmendations are made for improved quipment design requiring less monitoring and providing more control over the organization and difficulty level of the materials. Future on-the-site applications of programs similar to those used in this study would include cross-training to new positions, on-the-job proficiency training for those needing additional knowledge and/or skill development, and basic job knowledge training for those completely unfamiliar with SAGE and similar L-system tasks.

Project & Task: 1975-76892 Contract No. AF19(604)-5951
ASTIA No. AD260319

(321)
ESD-TR-61-20 May 1961

Swets, John A. (Massachusetts Institute of Technology); Tanner, Wilson P. Jr.; Birdsall, Theodore G. (University of Michigan)

DECISION PROCESSES IN PERCEPTION (Psychol. Rev., Vol. 68, No. 5, 301-340, Sep 1961)

This paper begins with a brief review of the theory of statistical decision and then presents a description of the elements of the theory of signal detection appropriate to human observers. Following this, the results of some experimental tests of the applicability of the theory to the detection of visual signals are described. The theory and some illustrative results of one experimental test of it were briefly described in an earlier paper (Tanner & Swets, 1954). The present paper contains a more nearly adequate description of the theory, a more complete account of the first experiment, and the results of four other experiments. It brings together all of the data collected to date in vision experiments that bear directly on the value of the theory.

Project & Task: 7682-76822 Contract No. AF19(604)-7459

(322)
ESD-TR-61-21 1961

Goldiamond, Israel (Arizona State University)

PERCEPTION (IN EXPERIMENTAL FOUNDATIONS OF CLINICAL PSYCHOLOGY)

This report is to appear as a chapter in the forthcoming book, The Experimental Foundations of Clinical Psychology, edited by Arthur Bachrach, to be published by Basic Books. Perception is defined procedurally, rather than as a variable or state intervening between stimulus and response classes, and the implications of this definition are considered, with special reference to some clinical areas. Although this applied area is singled out, the procedural orientation may have implications for other areas, since it is concerned with more general issues. These issues are raised by application to perceptual and monitoring situations of the experimental analysis, maintenance, and controlled alteration of behavior. The effects upon perceptual formulations of current advances related to communications and conditioning research are considered, and are applied to training, research, and other analytical problems. Specific consideration is given to the Theory of Signal Detection, operant conditioning research in discrimination, and generalization, and other recognition and verbal behavior (word) research.

Project & Task: 7682-76821 Contract No. AF19(604)-7991
ASTIA No. AD258854

(323)
ESD-TR-61-22 1961

Goldiamond, Israel (Arizona State University)

ONGOING VISUAL MONITORING: PROCEDURES FOR EXPERIMENTAL ANALYSIS AND CONTROL

Procedures for controlled alteration and definition of ongoing reading are presented. Reading not only has intrinsic interest, but can also be considered as a form of visual monitoring of a complex display, in which the behaviors required have linear sequences. Implications for other types of monitoring are presented. A page is projected on a screen, with the subject required to read aloud, or silently. Through the same optical system, an opaque loop is projected. This masks the presentation. A transparent slit on the opaque loop exposes part of a line; with each frame, the slit moves linearly and sequentially exposing successive reading material. Recycling of the loop triggers off presentation of another page. Control of each frame of the loop is by the subject, who presses a microswitch to advance the frame, thereby explicitly defining a reading response. The procedure is sensitive to variables such as signal-noise ratio, item difficulty, transient and long-term effects, pay-offs (contingencies) attached to responding, age. Procedures are suggested for training subjects to be differentially attentive to different parts of a display. Commercially available equipment is discussed which can be used for scheduled presentation and control of responses in the major psychophysical methods, for both human and animal monitoring research.

Project & Task: 7682-76821 Contract No. AF19(604)-7991
ASTIA No. AD269146

(324)
ESD-TDR-61-24 November 1961

Sumby, William H. (Operational Applications Laboratory)

A COMPARATIVE EVALUATION OF VIBROTACTILE WARNING SIGNAL POTENTIAL

The discriminative reaction times to auditory, visual and vibrotactile stimuli are compared. Reaction times to vibrotactile signals are at least as short as the reaction times for the other modalities, although more incorrect responses were made using that sense. Of greatest interest, however, the probability of a response being made to a vibratory signal appears to be the highest of the three. The implications of these findings are discussed.

Project & Task: 7682-768203
ASTIA No. AD291878

(325)
ESD-TR-61-25-1 June 1961

Brooks, W. Douglas (Educational Research Corporation)

THE DEVELOPMENT OF A PROFICIENCY TEST FOR SAGE MANUAL DATA INPUTS PERSONNEL

An earlier part of this project was to develop a prototype job-oriented performance test for the SAGE positions of Manual Data Input Supervisor and Technician. The primary goals of the present project were to up-date the test and modify it so that: (a) it could be administered and scored by Air Force personnel and (b) further forms of the test applicable to other SAGE Direction Centers could be constructed by in-service personnel. Since SAGE Direction Centers differ in their levels of operational readiness, it was found necessary to construct two different forms of the test: one based on Program Model 3 and the other on Program Model 5. The test based on Model 3 procedures was administered to Boston Air Defense Sector personnel, while the test using Model 5 procedures was administered to the personnel at the Syracuse Air Defense Sector. The amount of experience the Syracuse Sector had had with Program Model 5 was less than the amount the Boston Sector had had with Program Model 3, so the results from the two sectors could not be combined. Therefore, statistical tabulations were undertaken only for the data from the Boston Sector. The techniques employed in the construction and modification of the tests seem to be useful for the development of similar tests for local needs or for later programmed models. The tests were administered and scored with little difficulty by a number of different people, some of these being Air Force personnel. Within the limits of sample size and of the criterion information available, the form of test as modified appeared to be reliable and valid.

Project & Task: 1975-76892 Contract No. AF19(604)-5195

(326)
ESD-TR-61-25-3 June 1961

Curran, Robert J. (Educational Research Corporation)

THE DEVELOPMENT OF A PROFICIENCY TEST FOR SAGE IDENTIFICATION BRANCH PERSONNEL

An earlier part of this project was to develop a prototype, job-oriented performance test for the SAGE positions of Identification Officer and Technician. The primary goals of the present project were to up-date the test and modify it so that (a) it could be administered and scored by Air Force personnel and (b) further forms of the test applicable to other SAGE Direction Centers could be constructed by in-service personnel. In order to replicate the job as closely as possible, photographs were made of Situation and Digital Information Displays under actual job conditions. Even though the photographs were made at the Boston Air Defense Sector, the situations were found to be applicable to other sectors. The test was administered at three SAGE Direction Centers and at the SAGE Training School. Altogether, seventy-one (71) subjects were tested. The techniques employed in the construction and modification of the test seem to be useful for the development of similar tests for local needs. The tests were administered and scored with little difficulty by a number of different people, some of these being Air Force personnel. Within the limits of sample size and of the criterion information available, the form of test as modified appeared to be reliable and valid.

Project & Task: 1975-76892 Contract No. AF19(604)-5195
ASTIA No. AD407460

(327)
ESD-TR-61-26 June 1961

Wade, Edward A.; Janke, Leota L.; Stern, Robert M.; Lipsitt, Paul D. (Tufts University)

VIGILANCE, FATIGUE AND STRESS IN AIR SURVEILLANCE (SAGE)

Literature, bearing upon the performance of human monitors in air surveillance-systems is surveyed. Studies of vigilance visual search, monitoring, fatigue and stress are critically reviewed in terms of their implications for long-term monitoring behavior. Sections of the report treat display variables, signal variables, procedural variables and operator variables. Studies of visual and systematic fatigue, are examined together with studies of task-induced stress, environmental stress and personal stresses encountered by the operator. The data are related to operator duties in the SAGE-system. A number of recommendations, based upon the review, are made for improving and assuring the continued efficiency of human watchkeepers.

Project & Task: 1975-76891 Contract No. AF19(604)-5503
ASTIA No. AD267098

(328)
ESD-TR-61-27 June 1961

Gruber, Alin et al (Dunlap & Associates, Incorporated)

THE EVALUATION OF OPERATOR AND SYSTEM PERFORMANCE DURING THE PHASE 1, CATEGORY II FIELD TESTING OF THE 412L AIR WEAPONS CONTROL SYSTEM: A METHODOLOGICAL REPORT

The approach and methods used to evaluate a multi-site, semi-automatic air weapons control system are described. Following a description of the system, the measures used in evaluating system performance are discussed. The importance of analyses of system and subsystem functioning is mentioned with regard to determining both the data to be collected and also the method of collecting them. The data collected during the system testing are enumerated. Procedures used in collecting the data are discussed. Attention is drawn to the advantages of specifying in advance what observations are required, the form in which these observations are to be recorded, and the training of data collectors. The procedures used in programming for the data reduction and analysis are discussed.

Project & Task: 7684-76874 Contract No. AF19(604)-3029
ASTIA No. AD260086

(329)
ESD-TR-61-30 July 1961

Harris, Katherine S.; Liberman, Alvin M.; Eimas, Peter (Haskins Laboratories)

AUDITORY SIGNALING: ABSOLUTE IDENTIFICATION AND DISCRIMINATION OF SPEECH AND NON-SPEECH SOUNDS (See Also Liberman, A. M.; Harris, K. S.; Kinney, J. A.; Lane, H. The discrimination of relative onset-time of the components of certain speech and nonspeech patterns. J. Exp. Psychol., Vol. 61, No. 5, May 1961)

With synthetic speech stimuli that varied along an acoustic continuum and were heard as consonants, it was found (1) that discrimination is more acute across phoneme boundaries than within phoneme categories, and (2) that perception is nearly categorical in that discrimination is little better than would be predicted on the extreme assumption that the listeners can only hear the sounds as phonemes and can discriminate no other differences among them. By comparing discrimination of the speech-sound variables and the same variables in non-speech contexts, it was found that the discrimination peaks are learned, and that the learning consists entirely of an increase in acuity. If speech is perceived by reference to articulation, the perception of some consonants would be categorical because the articulation is categorical, but vowel perception should be different, since articulation can be continuous from phoneme to phoneme. An experiment confirmed that vowel perception is non-categorical: there are no peaks at phoneme boundaries, and discrimination is much better than expected on the assumption that the sounds can only be heard as phonemes. Mimicry of synthetic consonants provided further support for the above articulatory hypothesis: the speech gestures in mimicry are no less categorical than the perceptions.

Project & Task: 7682-76823 Contract No. AF19(604)-2285
ASTIA No. AD261354

(330)
ESD-TR-61-33 June 1961

Crumley, Lloyd; Divany, Richard; Gates, Stephen; Hostetter, Robert; Hurst, Paul (HRB-Singer, Incorporated)

DISPLAY PROBLEMS IN AEROSPACE SURVEILLANCE SYSTEMS PART I. A SURVEY OF DISPLAY HARDWARE AND ANALYSIS OF RELEVANT PSYCHOLOGICAL VARIABLES

This report describes the work done under Phase II of contract AF19(604)-7368, which has as its over-all objective the determination of the information presentation requirements of human data processing roles in future air and aerospace surveillance systems. Display parameters and operator characteristics which are relevant to display selection are described, and reviews of some of the pertinent literature are presented. The description and specification of operator roles is also included; these roles are based upon a conceptual model of a future air and aerospace surveillance system and a review of the state-of-the-art in displays.

Project & Task: 4691-46912 Contract No. AF19(604)-7368
ASTIA No. AD263543

(331)
ESD-TR-61-34 August 1961

Swets, John A.; Green, David M. (Massachusetts Institute of Technology); Tanner, Wilson P. Jr. (University of Michigan)

ON THE WIDTH OF CRITICAL BANDS (J. Acoust. Soc. Am., Vol. 34, No. 1, 108-113, Jan 62)

A different technique of analysis is applied to the experiment suggested by Harvey Fletcher for width of the critical band. This experiment determines the ability of noise bands of different widths to mask a pure tone centered in the band. The analysis considers two filters in series, one outside and one inside the observer. The width of the second filter (the critical band) can be estimated from measurements of the reduction in the noise power at the detector which is effected by the pair of filters. The width of the critical band is estimated under four different assumptions about the shape of the band. The results provide a context for discussing the reasons that may underlie the widely varying estimates of the critical bandwidth which have been obtained in previous studies.

Project & Task: 7682-76822 Contract No. AF19(604)-7459

(332)
ESD-TR-61-41 August 1961

Briggs, Peter (Massachusetts Institute of Technology)

ON HUMAN ADAPTIVE STRATEGY IN AN UNPREDICTABLE ENVIRONMENT

The interaction between human subjects and environment is studied in detail. The task is a hill-climbing problem in which the hill is simply a randomly pivoting ramp function. The buman varies two quantities, x_1 and x_2, while he observes changes in a third quantity z. Constraints are imposed upon the manipulation of x_1 and x_2 and upon the slope and possible orientation of the ramp; also, transition probabilities are introduced which govern the rotation of the ramp from one orientation to another. Assumptions concerning the mechanism of human choice behavior in this situation lead to the development of a single-parameter stochastic behavioral model. The expected performance of the model is compared with the experimentally determined average performance of human subjects. The results indicate that human adaptive strategy is essentially stochastic but is better described by a three-parameter model than by a single-parameter model; and certain non-stochastic elements in human adaptive strategy enable human subjects to consistently exceed the performance of both the single-and three-parameter stochastic models by a small margin, especially in highly variable environments.

Project & Task: 4690-46902 Contract No. AF19(604)-4548
ASTIA No. AD267388

(333)
ESD-TR-61-43 November 1961

Connolly, Donald W.; McGoldrick, Charles C.; Fox, Wyatt R. (Operational Applications Laboratory and Detection Physics Laboratory)

PRELIMINARY SUMMARY REPORT: TACTICAL DECISION MAKING II. THE EFFECTS OF TRACK LOAD ON DAMAGE, COST AND KILLS

An experiment was performed in which five highly trained and experienced subjects were required to perform threat evaluation and action selection functions under aerospace threat loads of from 60 to 96 incoming tracks. Their performance was measured in terms of the number of counter-weapons used against the threats, the number of threats destroyed thereby and the amount of damage sustained due to failure to prevent penetration of defended areas by hostile weapons. Comparisons are made between the performance of the human decision makers and the performance of an "idealized" system in the present experiment as well as in a previous experiment in which conditions of surveillance data quality, threat performance and counter-weapon capability differed. Differences in performance are explained largely by the differences in experimental conditions. While Experiment I showed superior weapon economy for the human decision makers, the same subjects in Experiment II appeared quite prodigal of their counter weapons. Both experiments demonstrate the remarkable capability of the human decision maker to approach the performance of an idealized system, even though he is operating in real time and under considerable stress.

Project & Task: 4690-46902
ASTIA No. AD285819

(334)
ESD-TR-61-45 December 1961

Connolly, Donald W.; Fox, Wyatt R.; McGoldrick, Charles C. (Operational Applications Laboratory and Detection Physics Laboratory)

TACTICAL DECISION MAKING: II. THE EFFECTS OF THREATENING WEAPON PERFORMANCE AND UNCERTAINTY OF INFORMATION DISPLAYED TO THE DECISION MAKER ON THREAT EVALUATION AND ACTION SELECTION

An experiment was performed in which five highly experienced subjects were required to perform threat evaluation and action selection functions under aerospace surveillance loads of from 60 to 96 incoming tracks. Other influential conditions were the overall flight performance level of the threats and the quality of the surveillance data presented to the experimental commanders. The most generally influential condition was task load, increases in which caused increased weapon consumption, an increasing but negatively accelerated rate of kill of threats, increasing and positively accelerating amounts of damage and increased reaction time. The load build-up rate beyond which commanders began to lag behind in the selection of counter actions was found to be of the order of 5-6 tracks per minute. The performance level of the incoming threat did not produce clear-cut evidence of effects upon the commander's success at their tasks. Tracks whose position and identifying/descriptive data were 50% - 60% complete and correct were handled in about the same way as tracks represented by perfect information. The commanders made only small numbers of inappropriate action selections. While the load range tested here began to cause deterioration of action selection performance, no drastic break point was found for any measure. It was found, however, that commanders based their actions upon only the broadest criteria, (e. g., threat vehicle class) and did not (or were unable to) make fine discriminations of relative or absolute threat.

Project & Task: 4690-46902
ASTIA No. AD288878

(335)
ESD-TR-61-47 April 1961

Shipley, Elizabeth F. (Massachusetts Institute of Technology)

DEPENDENCE OF SUCCESSIVE JUDGMENTS IN DETECTION TASKS: CORRECTNESS OF THE RESPONSE (J. Acoust. Soc. Am., Vol. 33, No. 8, 1142-1143, Aug 1961)

Forced-choice and yes-no auditory detection data were examined for single-trial dependencies of the correctness of the response. In both procedures a correct response is more likely when the previous response was correct than when it was wrong. The effect of various characteristics of the signal were studied in the forced-choice procedure: the dependence is more pronounced for higher-intensity signals and for signals of a pure tone rather than for an increment in background noise. An attempt is made to relate these findings to a criterion-correction explanation of the sequential dependence.

Project & Task: 7682-76822 Contract No. AF19(604)-7459

(336)
ESD-TR-61-48 June 1962

Adams, Jack A.; Humes, John M.; Stenson, Herbert H. (University of Illinois)

MONITORING OF COMPLEX VISUAL DISPLAYS: III. EFFECTS OF REPEATED SESSIONS ON HUMAN VIGILANCE (Human Factors, Vol. IV, No. 3, 149-158, Jun 62)

A vigilance experiment was performed using a visual monitoring task with multiple stimulus sources. Under investigation were effects of repeated sessions on monitoring behavior. Nine 3-hour sessions were given on consecutive days. Following a longer 7-day interval, a 10th session was given. The main findings were a significant decrement in detection latency within each session, but no statistically reliable evidence for a between-sessions effect. Evidence was presented to suggest that the spatial configuration of stimulus sources was a factor for vigilance decrement because efficiency of the observing response decreased as a function of observation time.

Project & Task: 9678-967803 Contract No. AF19(604)-5705
ASTIA No. AD409524

(337)
ESD-TR-61-49 September 1961

Indiana University

FINAL REPORT FOR CONTRACT AF19(604)-1962

Twenty abstracts of research in the field of hearing and communication accomplished under contract AF19(604)-1962 are presented. The personnel and the bibliography for the contract are listed.

Project & Task: 7682-76822 Contract No. AF19(604)-1962
ASTIA No. AD270808

(338)
ESD-TR-61-50 September 1961

Mayer, Sylvia R. (Operational Applications Laboratory)

MANAGEMENT CONSIDERATIONS IN THE IMPLEMENTATION OF PROGRAMED LEARNING

The training environment and unique training requirements of advanced military information systems are broadly reviewed. A prediction is made of the probable role of future programed instruction and/or teaching machines in these systems. A variety of management considerations are anticipated and described. Some of the considerations are tied to the limited level of automation achieved in currently available teaching machines and their associated technology. Others are related to the primitive state-of-the-art of task analysis and the analysis of knowledge. Others are simply hold-overs of training traditions which may no longer be appropriate in systems which incorporate advanced teaching machines.

Project & Task: 1975-76892
ASTIA No. AD279589

(339)
ESD-TR-61-53 October 1961

Adams, Jack A.; Boulter, Lawrence R. (University of Illinois)

AN EVALUATION OF THE ACTIVATIONIST HYPOTHESIS OF HUMAN VIGILANCE (J. Exper. Psychol., Vol. 64, No. 5, 495-504, Nov 62)

The activationist hypothesis contends that environmental and internal sources of stimulation, working through the reticular formation of the brain, are sources of human alertness. Two experiments were performed to identify stimulus determinants of vigilance decrement in a complex visual monitoring task. Experiment I sought to manipulate response-produced stimulation arising from the kinesthetic stimulation of head and eye movements and immediate memory. No effects of these variables on vigilance decrement were found. Experiment II asked if these negative results were related to amount rather than variety of stimulation being manipulated. The second experiment introduced variety in kinesthetic stimulation by training the pattern of visual observing responses and then changing the pattern on a trial. No effects on vigilance decrement were found. Problems of operationally defining the activationist hypothesis were discussed.

Project & Task: 1975-76893 Contract No. AF19(604)-5705

(340)
ESD-TDR-61-55 November 1961

Nickerson, Raymond S.; Brown, Charles R. (Operational Applications Laboratory)

A QUASI-RANDOM SEQUENCE FOR MEMORY EXPERIMENTS

A method is presented for constructing sequences with properties which make them useful in ordering stimuli for recognition memory experiments. A main feature of the method is the facility for controlling and efficiently manipulating the number of items occurring between the initial and subsequent occurrences of given items.

Project & Task: 9674-967406
ASTIA No. AD284784

(341)
ESD-TDR-61-56 December 1961

Hodge, Milton H.; Crawford, Morris J.; Piercy, Mary L. (University of Georgia)

THE CONSTANT-RATIO RULE AND VISUAL DISPLAYS

Three experiments involving a simple recognition task were designed to evaluate a model of choice behavior, the constant-ratio rule. The stimulus objects consisted of a set of circles which varied in area of brightness. The experiments also examined the effects of practice, interstimulus spacing, and stimulus range on the predictions of the rule. The results indicated that the rule predicts reasonable well the responses to single dimensional displays of visual area and brightness. However, it was also found that the predictions are sensitive to variations in practice, interstimulus spacing, and task difficulty.

Project & Task: 9670-96705 Contract No. AF19(604)-7299
ASTIA No. AD269860

(342)
ESD-TDR-61-57 October 1961

Grant, George; Hostetter, Robert (HRB-Singer, Incorporated)

DISPLAY PROBLEMS IN AEROSPACE SURVEILLANCE SYSTEMS

The over-all objective of this program was to determine the information presentation requirements for human data processing roles in future air and aerospace surveillance systems. The conclusions and recommendations listed herein are based upon information gathered in a comprehensive litcrature search and pertinent data reflecting the present state-of-the-art in displays and related human data proccssing roles. This information was reported in considerable detail in the previous Phase (Interim Engineering) reports. From the data available this report has endeavored to provide: (1) An approach to the problem of specifying and comparing human information presentation requirements (Section II). (2) A discussion of display problems and requirements based on currently available research data (Section III). (3) A structure for the collection and use of system information requirements in determining display needs (Section IV). (4) A technique (Profile Method) for use in screening and evaluating displays in terms of informational requirements (Section V). (5) A program for future research in areas that will optimize man as a component in the system (Section VI).

Project & Task: 4691-46912 Contract No. AF19(604)-7368
ASTIA No. AD271440

(343)
ESD-TDR-62-1 October 1961

Carter, N. L.; Kryter, Karl D. (Bolt Beranek & Newman, Incorporated)

MASKING OF PURE TONES AND SPEECH

The masking effects of intense pure tones and bands of noise upon other pure tones and speech were investigated. Of perhaps special importance are the masking effects of very intense low frequency sounds, in that low frequency sounds are present near missile launch sites. On the basis of the test results, spread of masking functions were obtained that can be incorporated into procedures for the calculation of a new "Articulation Index" that will be valid for a much wider variety of noise conditions than heretofore possible.

Project & Task: 7684-76842 Contract No. AF19(604)-4061
ASTIA No. AD271605

(344)
ESD-TDR-62-2 January 1962

Hodge, Milton H. (University of Georgia)

THE CONSTANT-RATIO RULE AND RECOGNITION TASKS

A review is presented of experimental studies designed to evaluate the constant-ratio rule as a predictor of confusion patterns in recognition tasks. The rule makes satisfactory predictions of the confusability associated with multi-dimensional stimulus displays and with relatively large single dimensional displays. As a model of choice behavior, the usefulness of the rule was judged to be limited becausc of its sensitivity to response bias.

Project & Task: 9670-967006 Contract No. AF19(604)-7299
ASTIA No. AD270938

(345)
ESD-TDR-62-3 October 1961

Kryter, Karl D. (Bolt Beranek & Newman, Incorporated)

THE VALIDITY OF THE ARTICULATION INDEX

French and Steinberg proposed the basic concept and method of calculating the Articulation Index (AI) approximately fifteen years ago. Although improvements and modifications of AI have been made over the years, it has not been generally accepted because of insufficient evidence as to its validity. On the basis of studies reported in the literature and on studies conducted under this contract, the present report shows that the Articulation Index is a valid predictor of the Intelligibility of Speech under a wide variety of conditions of noise masking and speech distortion. It is recommended that the Articulation Index be used to evaluate the performance of many speech communication systems when speech intelligibility testing of the system is not practical.

Project & Task: 7684-76842 Contract No. AF19(604)-4061
ASTIA No. AD272547

(346)
ESD-TDR-62-4 October 1961

Kryter, Karl D.; Flannigan, Gail; Williams, Carl (Bolt Beranek & Newman, Incorporated)

A TEST OF THE 20-BAND AND OCTAVE-BAND METHODS OF COMPUTING THE ARTICULATION INDEX

The calculation of the Articulation Index (AI) as originally formulated requires the preparation of a spectrum level analysis (energy per cycle) of the speech signal coming over a communication system and the noise in which the speech is imbedded. The speech and noise spectra are then divided into 20 narrow bands of frequencies each contributing equally to speech intelligibility. Unfortunately, the making of spectrum level analyses is a relatively laborious process and requires highly specialized laboratory equipment. For this reason it has been proposed that the calculation procedure for AI be modified to permit the use of octave band information as a substitute for spectrum level information (the equipment required to make octave band analyses is commonly available for use in the field). The studies herein reported were designed to test the accuracy with which AI's calculated by both the octave band and 20 band methods predict the intelligibility of speech presented to listeners in the presence of a variety of types of broad band noises. The results indicate that, for the noises tested, the octave band method for the calculation of AI can be used in place of the more detailed 20 band method without any appreciable loss in the accuracy with which speech intelligibility test scores are predicted.

Project & Task: 7684-768402 Contract No. AF19(604)-4061
ASTIA No. AD271606

(347)
ESD-TDR-62-5 May 1961

Moser, Henry M. (Ohio State University)

RESEARCH INVESTIGATIONS ON VOICE COMMUNICATION IN NOISE

The background and accomplishments of one year's research on International Language for Aviation are summarized, for the period 1 March 1960 to 28 February 1961. Included are abstracts of the nine research reports produced under the contract AF19(604)-6179.

Project & Task: 7684-768402 Contract No. AF19(604)-6179
ASTIA No. AD279865

(348)
ESD-TDR-62-14 February 1962

Stuntz, Stephen E. (Operational Applications Laboratory)

INTERNATIONAL LANGUAGE FOR AVIATION: A REVIEW OF AIR FORCE SPONSORED RESEARCH FROM 1952 TO 1961

The administrative provisions for this research are briefly reviewed. In Part I, reports of research are categorized and discussed under these topics: communication in English with non-native English speakers, comparative effectivess of ICAO and US-UK phraseologies, operational communications, voice transmission of numerals, basic and theoretical findings, miscellaneous secondary developments. A bibliography of 74 refercnces comprises Part II. An annotated bibliography of all reports, arranged by contracts, appears as Appendix I.

Project 7686
ASTIA No. AD278396

(349)
ESD-TDR-62-31 March 1962

Belanger, Pierre R. (Massachusetts Institute of Technology)

TIME-VARYING CHARACTERISTICS FOR THE HUMAN OPERATOR IN AN OPEN LOOP

This study utilizes the classical theory of time-varying networks, due to Zadeh, to describe randomly time-varying characteristics of the human operator of a control system. The present technique extends previous work on time-varying characteristics of human operators in that the complete spectra of amplitude and phase modulation can be measured. The method is applied to the performance of the human operator in tracking tasks without visual feedback. The human is required to track a random appearing target which is displaced as the sum of five nonharmonic sinusoids. The effects of various gains and dynamics of the controlled process are investigated. An estimate is given of the magnitudes and spectra of the time variation, though insufficient data were available in the present experiments for complete determination of the modulation spectra. The human's transfer function is found to vary randomly in time. The average open-loop characteristics show that with no dynamics in cascade with the human, the latter has more difficulty remembering the proper gain than the proper phase which he must apply in order to track accurately. When dynamics are introduced, it is seen that the human tends to forget the effects that the dynamics produced when tracking with feedback.

Project & Task: 4690-469002 Contract No. AF19(604)-4548
ASTIA No. AD275774

(350)
ESD-TDR-62-35 October 1961

Kryter, Karl D. (Bolt Beranek & Newman, Incorporated)

PROPOSED METHODS FOR THE CALCULATION OF THE ARTICULATION INDEX

The most valid and generally accepted procedure for measuring the ability of a communication system to transmit intelligible speech is to subject the system to a series of so-called speech intelligibility tests. However, speech intelligibility testing is an expensive and time consuming operation that requires laboratory test conditions. In an attempt to short-cut or make unnecessary this type of testing, a procedure has been developed for calculating from physical and acoustical measurements made on a communication system a measure that is indicative of the intelligibility scores that would be obtained for that system under actual test conditions. This measure is called the "Articulation Index" (AI). Methods of calculating AI have been improved and developed to the point where standard methods for its calculation can be proposed for use in the military and industry. The procedures presented in this report should be of benefit to communications engineers responsible for the design and operation of speech communication systems.

Project & Task: 7684-76842 Contract No. AF19(604)-4061
ASTIA No. AD275558

(351)
ESD-TDR-62-37 May 1962

Ganem, George P. (Operational Applications Laboratory)

ABSOLUTE JUDGMENTS OF VELOCITY

The present study was conducted to determine the maximum amount of information transmitted by observers in the absolute judgment of velocity. The study was subdivided into a series of five experiments in which 2, 4, 7, 10 or 19 sweep velocities of a 4-1/2 inch cathode ray tube--ranging from .70 inches per second to 300 inches per second (3.90° per second to 1688.70° per second of visual angle)--were presented to four subjects who were required to identify the stimuli with numbers ranging from 1 to 19. An informational analysis indicated that as the amount of stimulus information was increased the amount of transmitted information also increased, but at a decreasing rate, until a maximum of 2.23 bits of information was transmitted. Although anchoring effects occurred at both ends of the stimulus continuum, the low velocities were more accurately identified than were the high velocities.

Project: 9675
ASTIA No. AD278397

(352)
ESD-TDR-62-38 April 1962

Greenberg, Gordon Z. (Indiana University)

CUEING SIGNALS AND FREQUENCY UNCERTAINTY IN AUDITORY DETECTION

Three experiments are described in this report. The first experiment investigates the change in the detectability of identical auditory signals with temporal separation of the cueing signal from the detection interval. Measures of detectability are compared for listening with and without the cueing signal. The cueing signal was relatively ineffective as an aid to detection in this first experiment where only a single frequency was employed. The second experiment introduced frequency uncertainty in addition to that present in the first experiment and compared detectability with and without the cueing signal. With the additional frequency uncertainty introduced in this experiment, detectability increased in the presence of the cueing signal. The third experiment involved three listening conditions each with a cueing signal during every trial. As in the second experiment, frequency uncertainty was experimentally introduced. The three conditions differed in the relationship between the frequency of the cueing signal and that of the signal during the detection interval. The results of this experiment do not support a simple sensory facilitation as the explanation for the increased detectability in the cueing signal. The results support a description of the human listener's performance by the "narrow-band observer" model. Detectability during the detection interval was shown to be dependent upon the correctness of the frequency identification response during two of the three listening conditions. The author concurs with Green that even with fixed and specified signals the observer is largely uncertain regarding the parameters of signals. Introduction of additional uncertainty, as in the three experiments reported here, adds relatively little to the overall uncertainty. The increases in detectability in these experiments due to the introduction of the cueing signal were each of a magnitude of less than 1 db.

Project & Task: 7682-768202 Contract No. AF19(628)-266
ASTIA No. AD285570

(353)
ESD-TDR-62-41 May 1962

Hayes, John R. (Operational Applications Laboratory)

SCOPETRACE

A computer program for the Digital Equipment Corporation PDP-1 computer, but applicable in principle to other computers, is described. The program is designed to facilitate the debugging of object programs by providing a geometrical representation of the operation of the object program.

Project & Task: 2806-280607
ASTIA No. AD283383

(354)
ESD-TR-62-45 June 1962

Arthur D. Little, Inc.

STUDIES FOR THE DESIGN OF AN ENGLISH COMMAND AND CONTROL LANGUAGE SYSTEM

The report is concerned with research toward the design of natural language automatic fact retrieval systems for command and control applications. The difficulties of the problem are discussed and a research strategy formulated. A discussion is then given of the possible roles of syntactic information in sentence processing, and the Harvard computer program for syntactic analysis is described. Mathematical network models are developed for sentence retrieval using word associations. Finally, a procedure for testing the utility of syntactic information in retrieval applications is presented.

Project & Task: 2806-280601 Contract No. AF19(628)-256
ASTIA No. AD282244

(355)
ESD-TDR-62-47 March 1962

Clarke, F. R. (University of Michigan)

A STUDY OF THE ORGANIZATION OF DETECTION AND RECOGNITION SYSTEMS

This report summarizes the formal development of the method for applying the theory of signal detectability to the experimental study of the human observer. It deals with methods of generating rational mathematical models of human performance in target-detection situations, development of performance measures and experimental techniques, and some experimental results obtained with human observers.

Project & Task: 7682-768202 Contract No. AF19(604)-2277
ASTIA No. AD275057

(356)
ESD-TDR-62-48 July 1962

Hayes, John R. (Operational Applications Laboratory)

HUMAN DATA PROCESSING LIMITS IN DECISION MAKING

Four experiments are described in which subjects were required to choose among alternatives on the basis of two, four, six, or eight relevant facts. Both decision quality and decision time were measured. Presenting more than four facts caused a decrease in decision making efficiency.

Project & Task: 2806-280603
ASTIA No. AD283384

(357)
ESD-TDR-62-186 September 1962

Green, David M.; Sewall, Susan T. (Massachusetts Institute of Technology)

EFFECTS OF BACKGROUND NOISE ON AUDITORY DETECTION OF NOISE BURSTS (J. Acoust. Soc. Am., Vol. 34, No. 9, Part 1, 1207-1216, Sep 1962)

The ability of human observers to detect signals that are bursts of white noise is measured by two experimental procedures. In both procedures, the observer's task is to select the interval containing the signal from the two temporal intervals, marked by lights, which constitute a trial. In the first, the signal is added to a continuous background of white noise; in the second, the signal is added to one or the other of two equal noise bursts, that are added to the continuous background noise during the observation intervals. The psychometric functions obtained in the two experimental conditions are different. In the first experimental condition the psychometric functions are consistent with the assumption that the observer is uncertain about either the exact time when the signal occurs or its exact duration, or about both. In the second procedure, in which two noise bursts mark the observation intervals, the psychometric functions are consistent with the prediction of a statistical-decision model that assumes exact knowledge of the temporal occurrence of the signal. In this second procedure the signal-to-noise ratio for some constant level of detectability is considerably affected by the relation between the continuous background noise and the level of the two noise bursts. The minimum value of signal-to-noise ratio occurs when the continuous noise is~5-10 db more intense than the equal noise bursts; the signal-to-noise ratio increases from this minimum as the background level is changed in either direction.

Project & Task: 7682-768202 Contract No. AF19(604)-7459

(358)
ESD-TDR-62-190 August 1962

Busch, Allen C.; McNair, Robert J.; Kirby, Frederic J. (Electronics and Ordnance Division, Avco Corporation)

THE DATA FLOW ANALYSIS OF A MOBILE ATC AID

An analysis was made of the internal data flow of Air Traffic Control Central AN/TSW-5 modified to include a flight path prediction computer and a time schedule display unit. This analysis indicates that the modified semi-automatic AN/TSW-5 shelter operations are improved in the following ways: 1. improved controller ability to efficiently interleave arriving and departing aircraft; 2. improved controller cognizance of the entire traffic situation, thereby, allowing a safe reduction of minimum aircraft separation; 3. improved operational effectiveness under jamming; 4. provides for an acceptance rate in excess of 50 aircraft per hour by the AN/TSQ-47; 5. additional tools and means to compensate for failure of radar or other navigational aids are provided; 6. controllers become proficient at an earlier time in training experience cycle; 7. the decision making task load on the entire AN/TSW-5 control team is reduced. With computer path-prediction and scheduling provided, the communication channel load factor is less than 70 percent at all controller positions when handling 50 approaches per hour. Communications workload is not considered to be the limiting factor on the acceptance rate with the fully manual AN/TSW-5. The chief factor in a manual system is the extra margin of aircraft separation necessary because of the inability to precisely predict the flight paths of several aircraft converging from a multiplicity of directions toward a common final approach path.

Project: 2124 (431L System) Contract No. AF19(628)-244
ASTIA No. AD285218

(359)
ESD-TDR-62-191 July 1962

Brown, Charles R.; Hayes, John R.; Sumby, William H. (Operational Applications Laboratory)

THE CONCEPT OF AN AUTOMATED PSYCHOLOGICAL LABORATORY

The concept of an automated psychological laboratory is discussed. A small, expandable, digital computer will be the nerve center of such automation. The advantages gained from the realization of the concept are discussed in detail.

Project & Task: 2806-280607
9670-967001
ASTIA No. AD285610

(360)
ESD-TDR-62-196 July 1962

Baker, James D.; Whitehurst, Albert J. (Operational Applications Laboratory)

A COMPARISON OF TWO LOGIC SYMBOL CODING TECHNIQUES IN A SIMULATED DIGITAL DEVICE MAINTENANCE ENVIRONMENT

This study was designed to evaluate which of two techniques is better for encoding the logic symbols in detailed logic diagrams to convey information about digital circuits. One technique employed shape encoding to differentiate basic logic functions; and the other used alphabetic identifiers. The findings from this study showed that using shape encoded symbols in simulated detailed logic diagrams resulted in a significant reduction in the time required to solve maintenance type problems. Based upon observations made during the design and conduct of this study, two sets of recommendations are made. One set of recommendations has to do with research methodology; the second with operational conditions. Special programed handbooks were prepared for the pretraining and orientation phases of this study. These are included in an appendix to this report.

Project & Task: 9678-967801
ASTIA No. AD283487

(361)
ESD-TDR-62-207 August 1962

Forsyth, Daniel M. (Operational Applications Laboratory)

TEMPORAL MECHANISMS ASSOCIATED WITH INFORMATION PROCESSING BY THE VISUAL SYSTEM

The response of the visual system to complex intermittent stimulation was investigated. The stimuli consisted of repeatedly alternating trains of square-wave pulses. Both the number and period of the pulses in the two alternating trains were varied under more than 450 experimental conditions. Criterion measurements of fusion were obtained for each of two observers for all conditions. The stimulus waveforms at threshold were analyzed, and the frequency and amplitude of the fundamental obtained. Analysis was facilitated by use of an IBM 7070 computer. The resultant data were plotted in the form of amplitude-sensitivity curves for the two observers, and were found to be consistent with the view that the visual system operates as a low-pass filter. It was suggested that future research be concerned with the characteristics of the amplitude-sensitivity function, and not with the response to the stimulus waveform per se.

Project & Task: 9670-967001 (Prepared under Contract No. AF19(604)-8502
ASTIA No. AD291577 with Goucher College)

(362)
ESD-TDR-62-215 September 1962

Chaikin, Joyce D.; Corbin, Horace H.; Volkmann, John (Mount Holyoke College)

MAPPING A FIELD OF SHORT-TIME VISUAL SEARCH (Science, Vol. 138, No. 3547, 1327-1328, Dec 62)

The binocular field of vision during short-time search of a stimulus matrix was mapped and found to be ovaloid, with the longer axis horizontal and with the center of the field above the fixation point. The field expands in area as a function of exposure time, and there are frequent irregularities in its shape.

Project & Task: 7682-768204 Contract No. AF19(604)-3037

(363)
ESD-TDR-62-218 September 1962

Brown, Charles R.; Connolly, Donald W. (Operational Applications Laboratory)

TED: A TAPE EDITOR

The principle and operation of a utility program for the PDP-1 computer are described. The program is an aid in the editing or modification of alphanumeric text in that the operator may communicate with the computer in the very alphanumerics of the test itself. It is a computer time-saver in that the modifications and the control instructions for their accomplishments may be prepared at an inexpensive, off-line machine.

Project & Task: 2806-280604
ASTIA No. AD285472

(364)
ESD-TDR-62-228 October 1962

Duva, James S.; Devoe, Donald B.; McGoldrick, Charles C., Jr. (Operational Applications Laboratory)

DISPLAY SHARING THROUGH COLOR TILTERING: II.

Methods of display sharing through the projection of several different displays onto the same screen area and selectively viewing the displays with appropriate color filters and polarization techniques are described. Use of other devices for display sharing (dichroic mirrors, semi-specular screens) is discussed.

Project & Task: 9674-967405
ASTIA No. AD288879

(365)
ESD-TDR-62-294 November 1962

Giuliano, Vincent E.; Jones, Paul E. (Arthur D. Little, Inc.)

LINEAR ASSOCIATIVE INFORMATION RETRIEVAL

This paper is concerned with the recognition and exploitation of term associations for the retrieval of documents. A general theory of association and associative retrieval is presented; it is based on the use of linear transformations, both for establishing associations among terms and for discriminating among documents. The design and behavior of a simple experimental device which realizes the theory is discussed.

Project & Task: 5581-558106 Contract No. AF19(628)-256
ASTIA No. AD296313

(366)
ESD-TDR-62-305 November 1962

Egan, James P.; (Indiana University), Clarke, Frank R. (University of Michigan)

PSYCHOPHYSICS AND SIGNAL DETECTION

This report summarizes the research on voice communication in noisy environments. Optimum procedures are discussed for minimizing errors. The theory of signal detectability is reviewed in sufficient detail to indicate how voice communication procedures may be evaluated.

Project & Task: 7682-768202 Contract No. AF19(628)-266
ASTIA No. AD291450

(367)
ESD-TDR-62-306 November 1962

Coules, John; Ganem, George; Sumby, William H. (Operational Applications Laboratory)

ON THE SELECTION OF CODE-NAMES FOR COMMUNICATION SYSTEMS

Intelligibility of an untested set of code-names, 18 bird-names, for an Air Traffic Control Central (VOLSCAN) was studied under signal/noise conditions. The set was rejected because phonetically similar words were confused and large individual differences between listeners' accuracy scores occurred. Such large listener variability would not provide for an efficient communication system, particularly, when it may be jammed. Two new sets were constructed for a large set, labelled set 2, of 84 words. Set 3 was selected on the basis of two psycholinguistic factors, high intelligibility scores and variation in syllabic length. Although set 4 showed high intelligibility, it was rejected because large individual differences between subjects occurred. However, for these same subjects, when they listened to set 3, their accuracy scores showed insignificant variations and also high intelligibility. The major findings are (1) the selection of code names for a large list merely in terms of highest intelligibility is inadequate, and (2) individual differences between listeners' are practically eliminated when a list is based on high intelligibility and variation in syllabic length.

Project: 2124 (482L/431L System)
ASTIA No. AD292264

(368)
ESD-TDR-62-346 November 1962

Weiss, Edward C. (The Matrix Corporation)

A FIELD SURVEY OF A SELF-TUTORING COURSE FOR ON-SITE TRAINING IN SAGE AN/FST-2 TROUBLE-SHOOTING

A field survey was conducted to determine the present status of a self-tutoring course for on-site training in SAGE AN/FST-2 trouble-shooting. The materials were originally issued to AN/FST-2 sites in the New York and Washington Air Defense Sectors in the spring of 1961. The purpose of this survey was to determine any problems which might relate to the reissuing of the materials on a more extensive basis. In general the materials were well received in the field. However, two classes of problems were revealed. One is administrative in nature, while the other is technical. These problems are fully discussed and suggestions in the form of recommendations for their solution are offered. It was concluded that it would be feasible and desirable to reissue the materials.

Project: 416L System Contract No. AF19(628)-1953
ASTIA No. AD296022

(369)
ESD-TDR-62-351 December 1962

Sheridan, Thomas B. (Massachusetts Institute of Technology)

STUDIES OF ADAPTIVE CHARACTERISTICS OF THE HUMAN CONTROLLER

Several experiments are reported concerning the adaptive characteristics of the human operator of a control system. Both continuous-response and discrete-response control systems were studied. Descriptive models of both types of systems are discussed.

Project & Task: 4690-469002 Contract No. AF19(628)-242

(370)
ESD-TDR-62-352 December 1962

Cameron, Donald B. (Operational Applications Laboratory)

POST-DISCRIMINATION GRADIENTS AROUND STIMULI WITH DIFFERENTIAL RATES OF OCCURRENCE IN A DISCRETE RESPONSE TASK

Generalization gradients in an identification-type task reflect the willingness to apply identifying labels to stimuli which deviate from what might be called the "ideal standard" of a class. After training subjects to discriminate between pairs of ideal standard varied in both discriminability and frequency of occurrence it is shown that post-discrimination generalization gradients are characterized by a redistribution of identifying responses around the more frequent standard as a function of discriminability.

Project & Task: 9674-967406
ASTIA No. AD295583

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